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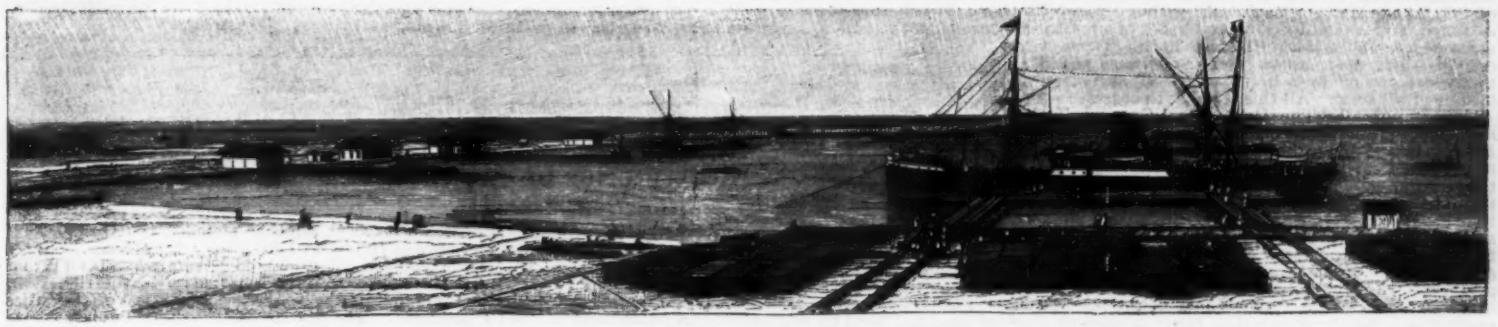
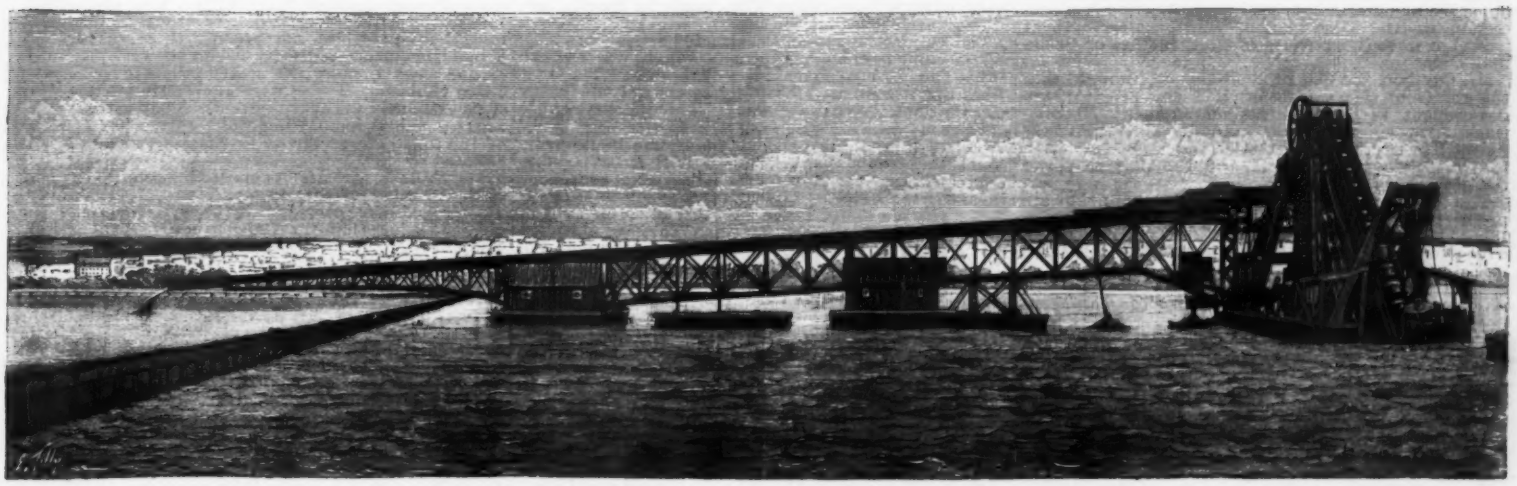


THE NEW PORT OF TUNIS, AND THE NEW WHARVES.



THE DREDGER DURING THE WORK IN THE PORT OF TUNIS.

THE NEW PORT OF TUNIS—THE AVENUE OF THE MARINE LEADING TO THE NEW PORT.

THE NEW PORT OF TUNIS.

TUNIS is to have an eight-day festival in order to celebrate its elevation to the so much envied rank of a seaport, and also to celebrate the arrival at its wharves of transatlantic steamers, which have hitherto been obliged to land their passengers and discharge their cargoes upon the rough and inclement roadstead of Goulette.

It is necessary to have entered this roadstead in bad weather, amid the thousands of craft that started from the old canal to take passengers and freight, and to have lost hours in landing, in passing through the custom house, in going by rail, in awaiting the hour of the trains, or in making the trip by boat, to appreciate the radical transformation of the voyage from Tunis due to the opening of the port to transatlantic and other large steamers.

After a voyage of thirty-two hours, the boat at anchor, it was for the passengers a series of manœuvers in equilibrium, beginning with a descent into a launch, and transshipments and losses of time, much more disagreeable than the trip itself. To the voyage of thirty-two hours were sometimes added as many as three or four hours of *ennui* and of tribulations of all sorts. All this is going to cease.

This is not all. The Compagnie General Transatlantique, which has fixed the hour for starting from Marseilles at 4 o'clock in the afternoon, in order to reach the roadstead of Goulette in the morning, so that the landing may be effected in broad daylight, will be able to modify its startings. Having no longer to fear an arrival at night, and the loss of time resulting therefrom in the roadstead, the company might, for example, fix noon as the starting time, after the arrival of the night lightning express at Marseilles, and reach Tunis in the afternoon of the following day.

It will be understood that Tunis, before the French occupation, fondly dreamed of being a seaport, just like Paris; and it is necessary to thank the Bone-Guelma Company for it, since it was the first to bring the question within the radius of a practical objective by obtaining in 1880 from Bey Sadok a concession of the port, which, shortly afterward, it passed over to the Society of Construction of Batignolles.

Mr. Cambon, the first resident-general, thought that the terms of this concession tied the hands of the government in an embarrassing manner. Negotiations were entered upon, and an agreement was reached in 1885. The concession was then converted into a public works contract, and the port remained the property of the state.

The studies had to pass through the channel of appropriations, and the project was approved July 18, 1888. It gave the Batignolles Society six years for the execution of the work; but this society equipped its fields of operations so well, and so judiciously and energetically prosecuted its work, that the latter is now finished—seventeen months before the time specified. Tunis and all travelers will be grateful to it for having so greatly abridged their torture.

What was it a question of doing? Tunis is separated from the sea by Lake Bahira, about six miles in width, which is separated from the gulf by a Lido so long and narrow that the ancients gave it the name of *tænia* (tape worm). A canal of a very picturesque aspect, with the fortifications that defended its mouth and the multitude of craft anchored in it, traversed this strip of land.

It was therefore necessary to pierce the Lido and to form in the lake, whose depth is less than three feet, a channel to permit ships drawing about eighteen feet to reach the port of Tunis.

An outer port was constituted by a channel dredged in the sea in bottoms of 23 feet. This has a width of 325 feet at the bottom, and is protected at the north by a large jetty of artificial stone, and at the south by a jetty of rock work.

In the lake the channel forms a straight line of about five miles. Its width is the same as that of the Suez Canal. It is connected with the sea channel by a curved section formed in the Lido. This complement has a length of 4,750 feet, and its bottom, starting from the normal width of 72 feet (in the lake), widens progressively to 325 feet, the width of the sea channel. A boat that enters the channel in the Goulette roadstead has therefore to make seven miles in order to reach the wharves of Tunis.

As the channel is in a straight line from the Lido to Tunis, the movements of the vessels are visible from both extremities, and signals are easy. In order to render such movements easier and more rapid, there is established in the middle of the channel a turn-out of 1,640 feet to permit vessels to pass each other. At Goulette, upon the north side of this channel, there has been constructed a wide basin 9 feet in depth, designed for barges. This basin is bordered by a masonry wharf.

At Tunis the basin has an area of 24 acres. Dredged, like the bottom of the channel, to a depth of 22 feet below low water, it is capable of receiving large steamers. It is bordered on three sides with wide terrepleins formed in the lake by means of the spoil extracted from the latter. This basin is now provided with temporary wooden landings for passengers and freight while awaiting its definitive installations, which are still under study.

SECTION OF THE CHANNEL.

The lake channel is protected against the entrance of sand and mud by embankments of rockwork in the vicinity of Goulette. In the crossing of the lake the channel is protected by two walls of piles and planks driven to a depth of about twenty-five feet. Each of these walls is more than 9,000 yards in length, say about eleven miles for the two.

The volume of the spoil extracted approaches 175,000,000 cubic feet, a good third of which was carried out to the open sea to distances of 12 miles. The two other thirds were used for filling in around the basin and for the walls of the channel. These latter, which are already growing green under a spontaneous vegetation, will some day become handsome boulevards, connecting Goulette with Tunis. Will it be possible to make large trees grow on them in order to render them shady? That is a question, for it often happens that a tree does not behave well until its roots reach the level of the sea water, and here they would meet it at a depth of two feet. Perhaps a solution of the question will be found. It would be admirable.

The 175,000,000 cubic feet of spoil taken from the channel would cover the Champs de Mars to a height of over thirty feet.

One hundred and seventy thousand tons of stone were taken from the Corbon quarries for use in the masonary and rockwork. Besides, 40,000 tons of sand and 10,000 tons of lime were used in the work.

Owing to the ingenuity, the precision and the excellence of the *materiel* employed in the removal of these masses of material and for these gigantic constructions, the society has been able to carry out the programme of its enterprise in a relatively short time.

The *materiel* of construction comprised the apparatus necessary for the manufacture and laying of the artificial blocks in the jetties, those for manufacturing the mortar, those for lifting and carrying, and lighters, pontoons, etc.

The dredging apparatus included a bucket dredger, with a long, jointed chute, capable of emptying the spoil at a distance of 90 yards beyond the walls, and another bucket dredger capable of emptying the spoil into lighters or forcing it through chutes to a distance of 400 yards.

To this must be added ten mud lighters, with valves, of from 5,300 to 7,500 cubic feet capacity, designed to carry the spoil to sea, four towboats and two steam launches and a fleet of tank lighters, pump boats, etc.

This colossal *materiel* was sent from the works of the Batignolles Society and mounted at Tunis. In less than a year, at the beginning of 1889, it began operations between Goulette and the capital.

It should be stated, in praise of the constructors of our time, that the type of the *materiel* devised at and sent from Paris by the society was able to operate without modification and without the least interruption until the work was entirely finished. Owing to these happy arrangements, the society finished the Lido embarkments and the southern jetty in August, 1890, the lake walls in March, 1890, the northern jetty in August, 1891, and the dredging of the channel and of the port of Tunis in 1893.

The number of agents and laborers, almost all of French nationality, varied from 400 to 700.

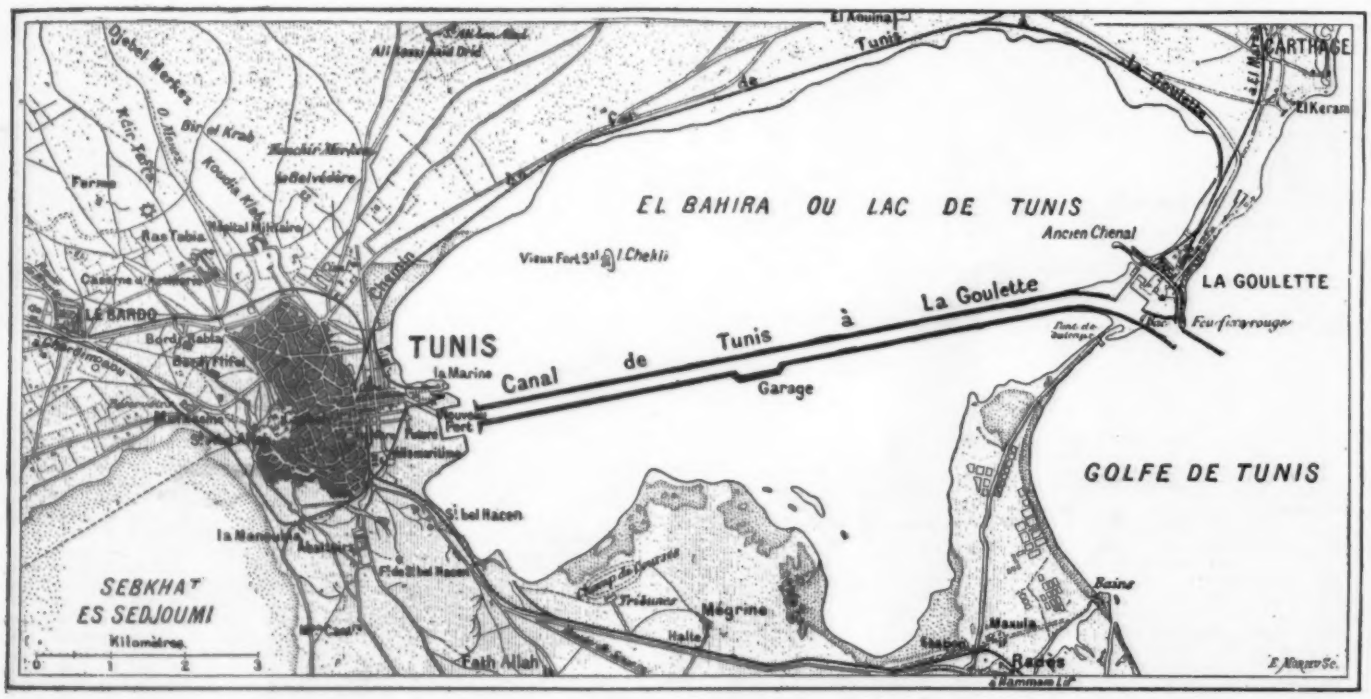
Let us add that the first ship that traversed the new channel was the steamer Tizza, of the Adria Company, of Trieste, carrying 12,000 stringers for the work.

Shortly afterward, another steamer, the Gallia, took on board in the basin 1,200 pilgrims for Mecca.

The Tunisian Mussulmans have always been proud of their capital, which is reputed to be the richest in monuments and the finest and healthiest of the cities of Moghreb. The travelers who visited Tunis prior to 1881 were far from partaking of such enthusiasm, at least as regards the city, which, like all Arabian cities, had no desire to cleanse itself. Garbage, horse manure and dead animals were thrown into the streets, and, as the latter were not lighted, it was dangerous to walk therein at night, not because there was any risk of bad encounters (as the Tunisians are very peaceable citizens), but because one risked falling over piles of filthy rubbish. There were sewers, but they were of an extremely primitive system. They carried their water to the encompassing walls only, whence it ran in the open air as far as to the lake. The air was polluted by it.

The French, who are to come to inaugurate the port of Tunis, will find that things have indeed changed. Twelve years of protectorate have transformed the city. It is not that the famous odors have entirely disappeared; Dr. Richard has made an analysis of the water of the lake that has revealed therein the presence of a surprising quantity of material in suspension. It will require time to purify itself; but, under the active direction of Mr. Jannin, the engineer of the city, the sewers have been covered and their water collected and sent to a lifting apparatus that sends it to a distance. The cause of infection has disappeared. The streets are now lighted with gas. A circular boulevard provided with street cars surrounds the city. The local fanatics long for the ancient dirtiness, because "it was more Arabic." Care has been taken to do nothing that might modify the Oriental character of the place. It remains intact with its tortuous lanes, its vaulted passages, its horseshoe arches and a swarming crowd in the Souks. There is no longer any need of boots and it is no longer an adventure to go thither.

Another surprise for the French who saw Tunis in 1881, and who are going to see it again, is that between the lake and the Arabian city there has sprung up another city, which is already very large and is made up of two or three story structures in the European style. This new comer is a visible sign of the progress that Tunis has made in twelve years of protectorate. In 1881 the land that it occupies was a mere waste at



GENERAL VIEW OF TUNIS, GOULETTE, AND THE NEW CHANNEL.

whose extremity arose, isolated, the residence of France. To-day a dozen or more streets, planted with trees, intersect blocks of high houses at right angles. Ten thousand Europeans, more than half of whom are French, live there. Great boulevards prolong these streets into the country. One of these, the Boulevard de Paris, leads to the Belveder, where the city is installing a large park, and the state an experimental garden. Another avenue, that of the Marine, leads to the new port.—*D'Illustration.*

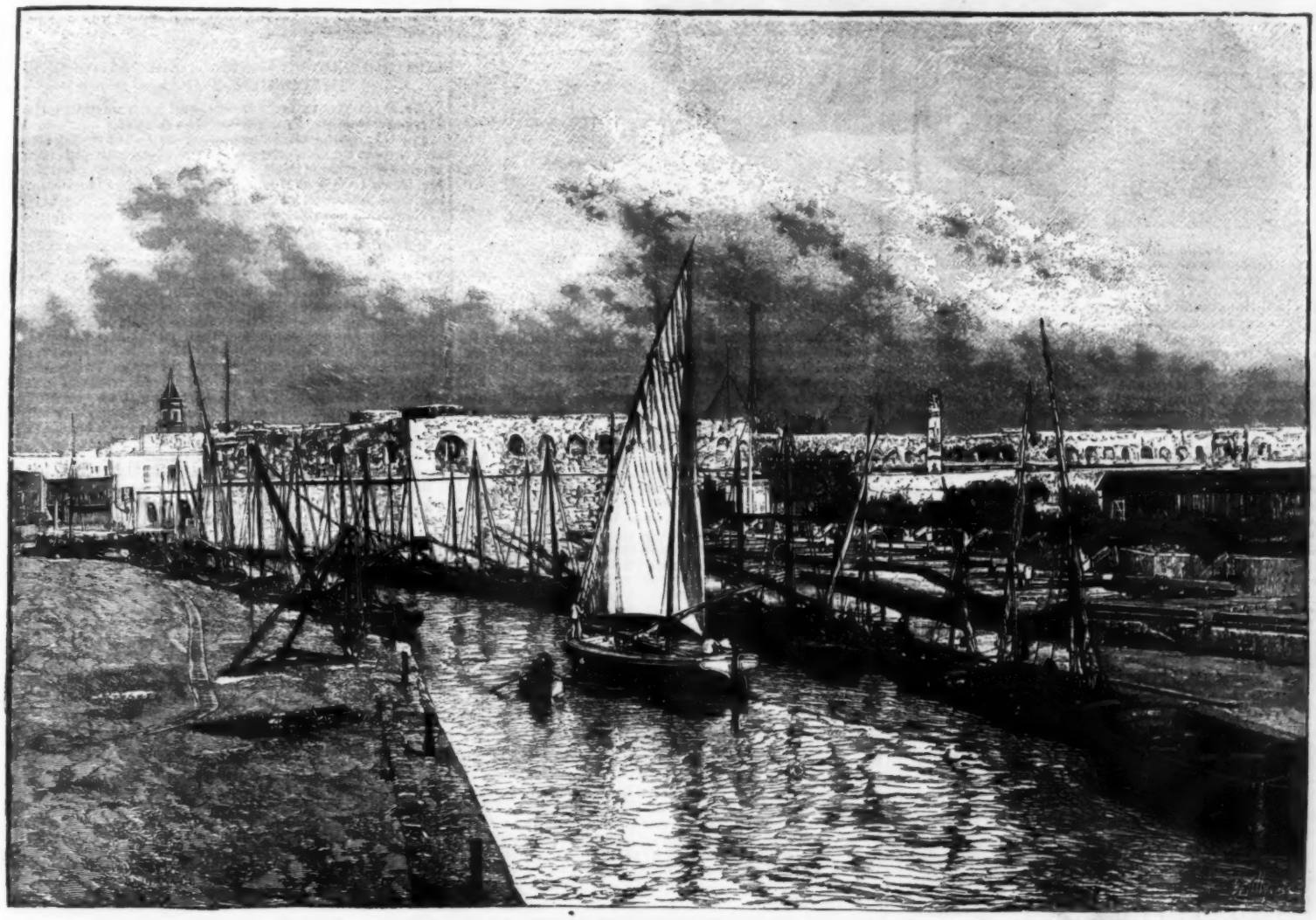
LARGE GAS ENGINES VERSUS STEAM POWER.

GAS engines have hitherto been looked upon by the majority of large power users very much as ingenious toys, useful, no doubt, in workshops and small industries, but quite unsuited to their own heavier requirements. A similar attitude has to a great extent characterized the makers of large stationary steam engines, who scarcely yet seem to regard the gas motor, even in conjunction with cheap gaseous fuel, as a serious rival to the powerful factory engine and its imposing battery of boilers. The fact, however, that within the last few months a single Midland firm, by no means the most widely known among gas engine makers, has replaced steam engines and boilers aggregating over 1,000 horse power in factories situated in England, Scotland, and Ireland with gas engines and special gas-making plant shows that the paramount position hitherto enjoyed by the steam engine is seriously menaced. The smallest of the installations alluded to is of 100 indicated horse power, and the largest of 400 indicated horse power, made up of four single Otto type engines of 100 horse power each. Several of these engines have been in satisfactory operation long enough to show that they are capable of easily fulfilling the guaranteed condition of indicating a horse power under ordinary conditions for less than 1¼ lb. of gas works coke per hour, or a correspondingly smaller quantity of suitable superior fuel. Other installations of equal and even greater importance are being arranged by the same firm, and as it may reasonably be assumed that other large makers are obtaining, or will soon obtain, orders of like magnitude, it seems probable that the gas engine industry may soon become one of the most important branches of mechanical engineering. Profits in these days of keen home and foreign competition are so fined down that few manufacturers can afford to overlook the important reductions in fuel consumption promised by the advocates of cheap gas power, especially as the promised reductions have to a great extent been fulfilled by numerous plants already in operation, some of which, though seldom if ever so powerful as those mentioned above, have stood the test of years of continuous work. Provided therefore that the new and important installations now being tried under widely varying conditions prove economical in fuel and satisfactory from a mechanical point of view, it would appear that the prospective business before the makers of large gas engines includes the gradual replacement of the majority of existing stationary steam engines. This represents a volume of business and a change in the established order of things calculated to furnish engineers with abundant matter for reflection.

The main factor in determining the future relative positions of steam and gas power will, of course, be the amount and cost of the fuel required per unit of power, and we think that those who have looked carefully into the matter will admit that the gas engine in its present development has the advantage. It is an indisputable fact that there are engines burning Dowson gas under ordinary working conditions, with a fuel consumption of only 1 lb. of anthracite per indicated horse power per hour, and we believe that even when burning inferior gas works coke in the generator, the consumption never rises higher than 1¾ lb. per horse power. We have not heard of any stationary steam engine, compound or otherwise, approaching this economy, and we shall probably not be far wrong in taking the consumption of the average factory engine at from two and a half to three times the above figures. So that after making due allowance for the fact that the mechanical efficiency of the gas engine is some 10 per cent. less than that of a high class steam engine, and for the higher price of anthracite or coke in most localities compared with small boiler coal, the gas engine will generally be able to show a large saving in the fuel bill. As regards the other items which go to make up the net expense of any given amount of power, the first cost of a good gas engine and gas-making plant will not exceed that of a high class steam engine with boiler power. The expense of maintenance and attendance will be about the same in both cases, but the gas installation will occupy less space, and all need of boiler insurance and danger of explosion will be done away with. The trouble, and even danger, which formerly attended the starting of large gas engines has now been obviated by the introduction of "self-starting" apparatus. Generally it may be said that a gas engine requires less looking after than a steam engine, and that about the most serious consequence likely to result from exhibitions of ignorance or extreme carelessness on the part of attendants is the stoppage of the engine. Further experience with large engines will afford additional information as to their capabilities, but even in the light of present knowledge the gas engine may safely be regarded as satisfactory from a mechanical point of view, while as a means of converting heat into work it has proved itself to be considerably more efficient than the steam engine. Moreover, when the possibilities of further improvement are considered, the gas engine appears to still greater advantage.

It is difficult to see how the stationary steam engine can be made more economical than the most perfect type of marine engine consuming 1½ lb. of the best coal per indicated horse power, without a complete revolution in existing practice, of which no signs are at present visible. With the gas engine, however, there are several obvious directions in which increased efficiency may be attempted with good hopes of attainment. In the generator itself 80 per cent. of the total calorific power of the fuel, which appears as sensible heat in the process of gasification, is completely lost, partly by radiation and conduction, but mainly through the cooling of the gas during the water scrubbing operation to which it is necessarily subjected before being passed on to the engine. It appears to be quite feasible to return, by means of a suitable recuperator, a considerable amount of this heat along with the air and steam entering the generator to maintain combustion. Whatever quantity of heat could be returned to the fuel by this means would allow of the decomposition of a correspondingly larger volume of steam, and so increase the quantity of combustible gas obtainable from a given weight of fuel, while at the same time the proportion of objectionable nitrogen would be reduced. If one-half of the heat resulting from the conversion of the carbon of the fuel into carbonic oxide could be utilized in this manner, it would give a substantial economy. Such a system has been proposed and, we believe, patented, but hitherto the makers of gas plant for motive power purposes have in practice scrupulously avoided, and perhaps wisely, any tendency to complication of details.

The ascertained disposal of the heat of combustion in some gas engines shows that about 23 per cent. of the total is converted into indicated horse power, 10 per cent. is lost by radiation, and 22 per cent. passes away with the exhaust gases. The remaining and largest loss, amounting to some 45 per cent., is due to the cooling action of the water jacket, and serious as this abstraction of heat undoubtedly is, it seems to be in a large measure unavoidable. The internal working surfaces must be kept sufficiently cool to preserve the lubricant, and a temperature high enough to cause danger of ignition during the compression stroke is inadmissable in any part of the combustion cylinder of engines working with explosive gaseous mixtures. It is quite different, however, with the loss due to the heat carried off by the exhaust gases, and it seems highly probable that further economy may be effected at no distant date, either by restoring a portion of the heat now wasted to the gas generator when it is placed near enough to the engine or by increasing the range of expansion. Large gas engines at present work with initial and final pressures of about 270 lb., and 30 lb. per square inch, and any reduction of the pressure at which exhaust commences, effected without the introduction of other losses in mechanical and thermo-dynamic efficiency, will mean an important gain. Taking all circumstances into consideration, it does not seem improbable that large gas engines may soon be working with a fuel consumption of ¾ lb. per indicated horse; and that even in their present stage they have assumed an importance which neither power users nor engineers can afford to overlook.—*The Engineer.*



THE ANCIENT CANAL OF GOULETTE, NEAR TUNIS.

A WATCH for the blind is among the newest inventions. A small peg is set in the middle of each figure. When the hour hand reaches a given hour the peg for that hour drops. To know the time, find which peg is down, and then count back to twelve.

SERPOLLET'S STEAM ARTILLERY WAGON.

SINCE 1888, the epoch at which Mr. Serpollet made known his generator for the instantaneous production of steam, the inventor has been engaged in developing its applications, principally for the propulsion of vehicles of all kinds, for which this generator is so well adapted. After the velocipede came the phaeton, and then wagons for six and eight passengers, and still are to come the omnibuses and the tramway cars now in course of construction.

But the success obtained in the construction of the light vehicles designed for the carriage of passengers has had the effect only of exalting the inventor's ambition, instead of satiating it, and he is now attacking difficulties before which he would have hesitated but a few years ago.

FIG. 1.—SERPOLLET'S STEAM ARTILLERY WAGON.

The wagon that he has just finished for the artillery service solves a problem of great importance, and proves the possibility of the mechanical carriage of the heaviest loads on ordinary roads and even on such as are not kept in good repair.

The problem to be solved was as follows: To render self-moving a wagon of large dimensions capable of containing a load of ammunition or merchandise of a weight of 3,300 pounds, and, with this load, capable of running a distance of 24 miles without stopping, at a mean speed 4·8 miles per hour, whatever be the state of the roads, gradients included; this same wagon to be able to haul a second one in its train, loaded with 6,600 pounds of useful weight, and, with this new charge, the speed to be, on an average, only 2·4 miles per hour; to utilize for this purpose an already existing wagon without making any change in its arrangement, the ordinary system of fore-carriage being preserved and the pole being replaced by another controlling piece.

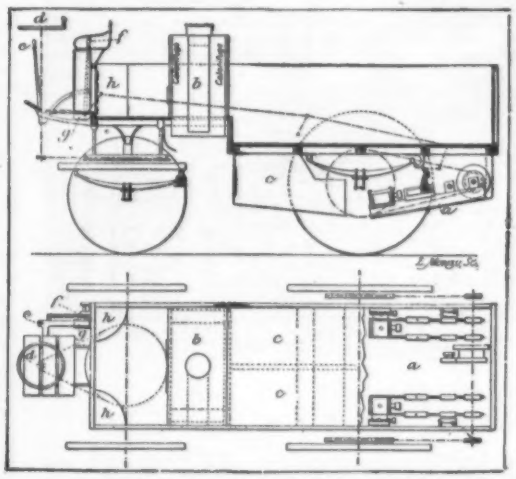


FIG. 2.—SECTION AND PLAN OF THE WAGON.

a, motor; *b*, generator; *c*, water tank; *d*, steering apparatus; *e*, lever of the starting pump; *f*, reversing lever; *g*, starting pump; *h*, coal bunkers.

The experience acquired by Mr. Serpollet in the construction of numerous types of self-propelling vehicles permitted him to respond in a complete manner to all these desiderata. It was necessary for this to employ a motive apparatus that should be exceedingly strong and relatively very powerful and at the same time light. The mean power to be developed at a speed of 9 miles an hour corresponds to 15 horses, but, on account of the extra efforts in starting on roads in poor repair, on metaled roads, or on gradients, the motor had to be able to produce as high as 40 h. p.

In order to attain its mean power, the motor works at a pressure of 770 pounds to the square inch, but its parts have been studied with a view to supporting pressures reaching 25 atmospheres. The generator employed is of 15 h. p., but on account of its elasticity of production, it is capable, in difficult passages, of momentarily quintupling its power and of giving an impetus that the strongest horses would be absolutely powerless to exert.

The diagram in Fig. 2 shows the suspended artillery wagon and the arrangements of the mechanical adaptation that have converted it into a self-propelling steam wagon. The motor is placed in the rear under the floor of the vehicle. It has two cylinders and a change of direction by the Stephenson slide. The diameter of the pistons is 5 inches and their stroke also is 5 inches. The motor actuates the two driving wheels through chains of a special system connected with the driving wheels by an intermediate shaft with two rates of velocity. This shaft carries the differential movement.

The motor thus placed is very accessible either for lubrication or the inspection of its parts. In addition, through its weight placed beneath the axle, it gives the wagon a perfect stability. It is covered and well protected from dust. The water tanks, placed under the floor, contain a sufficient supply for a mean run of 24 miles. The generator, arranged at the front of the wagon, consists of 24 straight tubes 22 inches in length. Owing to the improvements introduced into the manufacture of the generators, its weight does not exceed 990 pounds, which corresponds to a most remarkable specific power, and the putting of it under pressure requires but fifteen or eighteen minutes.

Nothing has been changed in the form of the wagon. The engineman sits in front on the seat formerly occupied by the driver. He has at his right side the lever of the starting pump and the reversing lever, and at his left the regulator of admission of water to the generator. The steering is effected through a hand wheel. The brake is of the Lemoine system, controlled by a pedal.

As may be judged from the reproduction of a photograph shown in Fig. 1, the wagon is not at all unsightly. As for the facility of maneuvering it, that is as great as that of other wagons and greater than that of the vehicle drawn by horses. The figures taken in different trials at several stages of a trip of 24 miles have furnished the following mean results: Speed, 8·4 miles per hour; coal used, 10 pounds per mile; water, 28 pounds.

Gradients of 13 per cent. have been ascended without any difficulty, the wagon then having a weight of 9,460 pounds. These figures naturally lead to a comparison with traction by horses. The expense of fuel for a trip of 24 miles, counting coal at $8 per ton, is 80 cents, adding 10 cents for lubrication, it costs but 90 cents to carry 3,300 pounds to a distance of 24 miles. Let us compare this expense with that which would accompany the number of horses necessary to make the same distance in the same time, and we shall see that the first is not a third of the second. Besides, when the wagon under consideration has traveled 24 miles, it suffices to replenish its supply of water and fuel in order that it may immediately start on a similar journey. It would be impossible to call upon horses to repeat such a work.

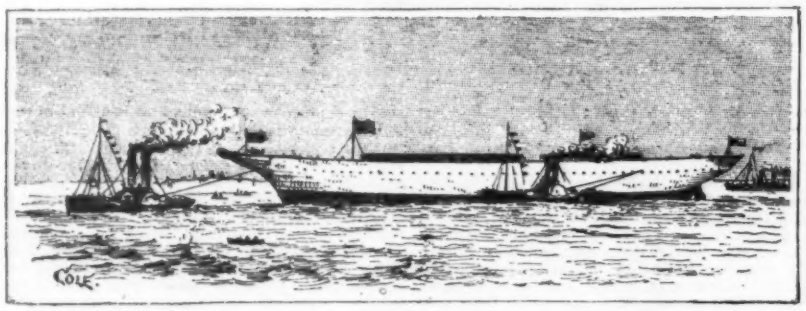
The success of this tentative has permitted of the undertaking of the construction of several twelve-seat omnibuses designed to connect villages that have no regular and rapid means of communication. These omnibuses are already in process of construction and we hope to have an opportunity before long to describe them to our readers.

The Serpollet generator, now that one has succeeded in constructing it for powers of twenty horses, gives an economical solution, simple and full of security, of the question of propelling street cars where the problem to be solved is much less complex than in the self-propelling wagon for heavy loads, and it will before long come into competition with the present processes of traction and propulsion—horses, cables, electricity, compressed air, gas, etc.—*La Nature*.

MR. VANDERBILT'S NEW YACHT.

THE new steel yacht Valiant, built for Mr. W. K. Vanderbilt, the New York millionaire, was recently launched from Messrs. Laird's yard on the Mersey, to replace the celebrated floating palace Alva, sunk by collision last year. The Valiant's length over all is 320 ft. (between perpendiculars 290 ft.), with a beam of 38 ft. 6 in., moulded depth about 24 ft., and draught at load line 15 ft. There are two sets of inverted direct-acting triple expansion engines of 2,250 (indicated) horse power, with a guaranteed speed of 17 knots. The diameter of the high-pressure cylinder is 23 in., intermediate cylinder 36 in., low-pressure cylinder 55 in.

The ship is probably the largest private yacht afloat, having 2,500 registered tonnage. The interior finish is something wonderful for beauty and comfort. The main saloon, 21 by 36 ft., is in the Louis XVI. style, mahogany furniture, with brass mounts, wall panels of silk and white enameled wood, the ceiling white with gold. The library, 20 by 35 ft., and other apartments on same generous scale; all finished in a style of marvelous beauty.



LAUNCH OF MR. VANDERBILT'S NEW YACHT VALIANT.

LUMINOUS DISCHARGES IN ELECTRODELESS VACUUM TUBES.

MR. E. C. RIMINGTON lately read a paper before the Physical Society, London, on this subject.

The luminous rings produced in exhausted bulbs and tubes by discharging Leyden jars through coils surrounding them had, he said, been attributed by Mr. Tesla to the electrostatic action of the surrounding wire rather than to the rapidly varying magnetic induction through the rarefied gas. The present paper describes several experiments bearing on this point, which leads the author to conclude that varying magnetic induction is the chief cause of the luminous rings. They also show that a superposed electrostatic field greatly assists the production of the luminosity. Most of the experiments described were performed before the meeting, some of the effects being particularly brilliant. In one experiment an exhausted bulb was placed within a coil connecting the outside coatings of two Leyden jars, and placed between two metal plates which could be connected at will with the outside of either jar. The spark gap between the inner coatings was then arranged so that no luminosity was seen in the bulb. On connecting one or both the metal plates with the jars in such a way as to increase the electrostatic field through the bulb, bright rings immediately appeared. An electrostatic field, produced by a small induction coil connected to a piece of tin foil on the bulb, caused the rings to form at irregular intervals when the discharge of the jars and coil happened to be properly timed. In another experiment two loops of wire in series were used, and when put on the bulb in such a way as to produce a large magnetic effect but small electrostatic field, bright rings appeared; but if the magnetic effects of the coils opposed each other, while the electrostatic field was increased, no rings were seen. The subject is treated mathematically at some length in the paper, the times at which the maximum values of the current—the potential difference between the outsides of the jars and the rate of change of current—occur, as well as the values of their successive maxima, being determined. The influence of "size of jars" is next considered, and the time integral of rate of change of current on which the effect on the eye depends expressed as a geometrical series. Taking an approximation, the author shows that the time integral is roughly proportional to the fourth root of the capacity. Large jars are therefore theoretically only slightly better than small ones, and this agrees with observation.

On the subject of "apparently unclosed discharges," such as are seen when discharges pass through a coarse spiral wound on an exhausted tube, the author said he had observed that the discharges were really closed, but the return part was much diffused and of feeble intensity. Experiments were exhibited showing that under some circumstances an exhausted bulb acted like a closed metallic circuit, while under other conditions dissimilar effects were produced. Another experiment was shown in which a faint luminous ring produced by a single turn of insulated wire round a bulb was apparently repelled on touching the wire with the finger. The author also showed that fan-shaped luminosities could be produced by rotating an exhausted tube in the electrostatic field produced by a charged ebonite or glass rod.

Dr. Sumpner, speaking of the apparently unclosed discharges, pointed out that they might be closed

through the wire forming the primary circuit in the same way as a coil of a transformer might be arranged to act, partly as primary and partly as secondary.

Mr. A. P. Trotter, after referring to Dr. Bottomley's researches, said it was important in discussing such experiments to distinguish between electrostatic and electromagnetic effects. In Mr. Campbell Swinton's experiments the luminosity always appeared to get as far away from the wire as possible, and to be at right angles to it; whereas in Mr. Rimington's the luminous portions were close to the wire. With a view to puzzling the discharge in Mr. Swinton's tubes, he had made a right-angled bend in the spiral surrounding the tube, the result of which was to make the luminosity discontinuous, one end of the break being bifurcated. In all Mr. Swinton's experiments brush discharges surrounded the wire.

Prof. S. P. Thompson thought an electrostatic field would aid a discharge even if its direction was not the same as the E. M. F., due to varying magnetic induction. Planté had found that vacuum tubes, through which 800 cells were insufficient to produce a discharge, immediately allowed a discharge to pass when a rubbed ebonite rod was brought within about ten feet distance. This effect was found to be independent of the direction of the disturbing field. Analogous effects had also been observed by Prof. Schuster, and described in his Bakerian lecture.

THE BISMUTH MAGNETIC FIELD EXPLORER.

By Dr. TH. BRUGER.

A MAGNETIC field explorer, shown in Fig. 2 on this page, and based on the property of bismuth of varying its resistance in magnetic fields, is coming into use in Germany of late years, and a description of the instrument and a discussion of its properties and capabilities may be of interest.

This instrument has been brought out by Messrs. Hartmann & Braun, of Bockenheim, Frankfort-on-Main. Its action depends on the property of bismuth, discovered by Righi, of altering in resistance when placed in a magnetic field. The law of the relation of the resistance to the induction has been found by Leduc to be

$$f = a\sqrt{z\,(z+b)}$$

where f is the induction, or, as it is frequently called, the number of lines of induction per square centimeter, and R_o the variation of the resistance when the bismuth spiral is taken from a zero field where its resistance is R_o to a field of intensity f, and a and b constants:

$$Z = \frac{R_f - R_o}{R_o}$$

Dr. Lenard has found that the best form for the bismuth conductor is a flat spiral, wound double, so as to be arranged non-inductively. The bismuth employed is rendered chemically pure by electrolysis, as the slightest impurity would impair the sensitiveness of the instrument very seriously. The bismuth wire is wound into a flat non-inductive spiral and inclosed between two plates of mica to protect it against any rough usage. The flat spiral is mounted on two strong copper rods, which pass through the insulating handle to the binding screws. The instrument is shown in Fig. 2. It is calibrated by being inserted in a field whose intensity is known and can be regulated. Fig. 1 is a curve showing the relation between the increase of resistance and the induction. The ordinates are the variations in resistance, and the abscissæ are induction in C. G. S. It will be seen from this curve that in weak fields Leduc's formula may be applied, but after the induction has reached 6,000 or so the curve becomes practically a straight line, which does not, however, pass through the origin if produced. The sensitiveness of this instrument is surprising. It will be seen that in strong fields such as those used in practice the resistance of the spiral is nearly doubled. In the air gap of a dynamo it is increased some 30 to 50 per cent. When using the specific resistance of bismuth to determine magnetic fields, it is important to eliminate errors due to the rise of resistance caused by rise of temperature. In order to eliminate this, readings in the magnetic field and out of it may be taken in rapid succession, so that the temperature of the spiral of bismuth has not time to alter between the readings. The arrangement of Wheatstone bridge adapted for giving direct readings is shown in Fig. 3. O D and D C may be regarded as the ratio coils of the bridge, and are made up of equal resistances of one ohm. O A is a stretched wire with a movable contact, S_1. The other two of the four sides of the bridge are made up of the spiral of bismuth between the terminals, A and B, and the resistance, E, and part of the slide wire extending from it to B. To use the bridge the contact S_1 is put at O, so that the ratio elements of the bridge are equal. The contact S_2 is moved till there is no deflection on the galvanometer. This is when the resistance of the spiral is equal to that of E and the part of the slide wire included inside the contact S_2. The slide wire is thus used merely to add resistance to E to allow for the temperature alteration of the bismuth. The explorer is then put in the field to be measured. The resistance increases so that the contact S_1 is moved out toward A till a balance is shown. If the balance is obtained at F, for instance, the increase of resistance of the spiral is in the ratio of F O to O D. As O D is 1 ohm, O A is also graduated in fractions of an ohm, so that the reading gives the increase of resistance; that is to say,

$$\frac{R_f - R_o}{R_o}$$

direct, without any calculations or references to tables.

Messrs. Hartmann & Braun have also worked out a piece of apparatus in which the rise of resistance of bismuth is utilized to give induction readings for testing iron. I am not, however, yet at liberty to describe this interesting piece of apparatus.—*Industries.*

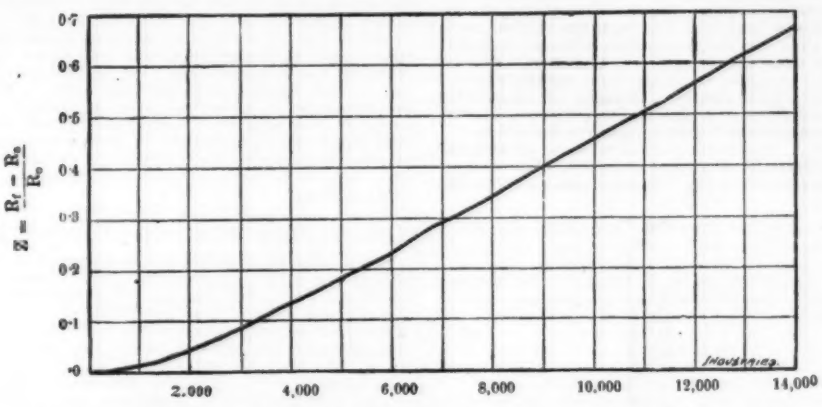


FIG. 1.—DIAGRAM SHOWING RELATION BETWEEN THE INCREASE OF RESISTANCE AND THE INDUCTION.

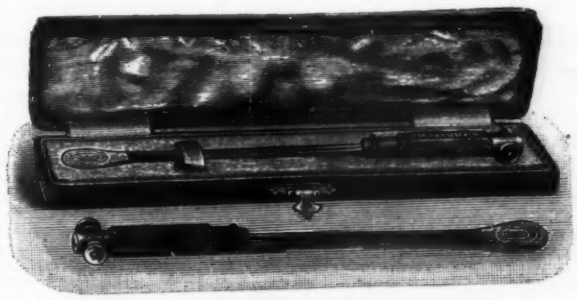


FIG. 2.—INSTRUMENT AND ITS CASE.

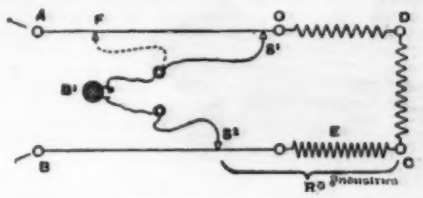


FIG. 3.—ARRANGEMENT OF WHEATSTONE BRIDGE.

ALLOY BY ELECTRO-DEPOSITION.—S. O. Cowper-Coles. — According to this invention, articles are coated by electrolysis with an alloy of silver containing from 25 to 35 per cent. of cadmium, or when less costly coatings are required, 40 to 90 per cent. of the baser metal may be employed. The bath is formed by dissolving cyanide of cadmium in a solution of cyanide of potassium so as to form a double salt having a slight excess of the latter. To this solution is added a small quantity of the double salt of the cyanides of potassium and silver, the two together forming the electrolytic bath. The anode is composed of an alloy of cadmium and silver in the same, or approximately the same, proportions as are desired in the alloy to be deposited.

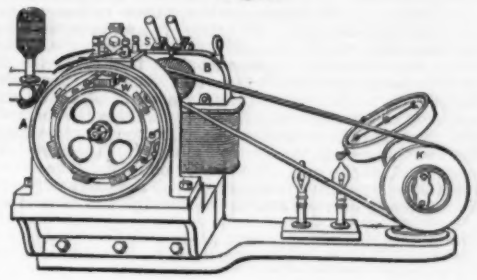
THE ROYAL SOCIETY CONVERSAZIONE.

A CONVERSAZIONE of the Royal Society took place recently at Burlington House, under the presidency of Lord Kelvin.

Sir David Salomons, Bart., and Mr. L. Pyke, the *Engineer* says, placed on view a large show of scientific apparatus, chiefly in relation to high-tension electricity. One machine was an alternator with a periodicity of one million alternations per minute; the electromotive force used for the motors was 100 volts, the current consumed about 40 amperes, and the output from the alternator was 200 volts, and about two amperes. This machine changed a continuous current of 100 volts and 8 amperes into an alternating current having an E. M. F. of 100 volts, and an alternation rapidity of one million per minute. This is effected by means of a motor-driven alternator, the requisite alternation frequency being obtained without an excessive speed by rotating the field and armature of the motor in opposite directions, the brushes of the commutator proper being carried by the field.

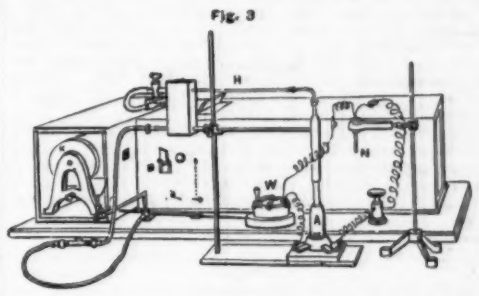
They also exhibited an inductor dynamo and motor represented in Fig. 1. The alternator, A, stands on a base 20 in. by 9 in., and gives at 740 revolutions per minute an electrical energy of one horse power. The field is excited by one or two cells of a storage or other battery, and the efficiency of the alternator exceeds ninety per cent. B is the continuous current motor and K the tachometer which registers the number of alternations; the rotating inductors are at W. At a speed of 2,000 revolutions per minute, the output of the machine is 1½ kilowatts; this efficiency is ascribed to the close construction of the magnetic field, and to the whole of the metal being laminated where subject to even the smallest variation of magnetic density. This machine renders it possible to light a large number of small transformer lamps with short primaries. By means of six transformers some vacuum tubes were thus brilliantly illuminated. One of the transformers is represented in Fig. 2, and consists of a combination of an induction coil, vacuum tube, and socket for attaching to a lamp holder; with supply companies alternating current circuits, it raises a normal E. M. F. of 100 volts to 5,000 volts.

Fig. 2 Fig. 1



Professor Roberts-Austen exhibited a pyrometer which can be used either to make its own records by photography or the indications can be read off by an observer. The instrument is represented in Fig. 3, and the end of the recording drum, covered with photographic paper, is shown at K. In front of this rotating drum is a long horizontal slit in a wooden partition, through which a small portion of a vertical line of light thrown by the mirror of a dead-beat reflecting galvanometer reaches the paper a moving luminous spot. A mirror inside the larger box, when placed at an angle of 45°, reflects the indications to a ground-glass screen at the top of the box, where they can be read off by the eye. H represents the lid which, when shut down, covers the glass screen. The temperatures of furnaces are ascertained by their influence upon a thermal couple, one element of which is of platinum, and the other of an alloy of platinum with ten per cent. of rhodium, and at the conversazione these were placed in a little furnace heated by an oxyhydrogen blowpipe, as represented in the cut. The thermal couple was connected by means of the pictured switch with the dead-beat galvanometer inside the box, and the switch was made to put the apparatus in connection with six furnaces in succession. In the experiments of the evening N was fitted up as an independent couple, representing a second furnace. Some curves obtained by means of this instrument were exhibited; they had been obtained in connection with the measurement of the temperature of the hot blast supplied to blast furnaces smelting iron, and Professor Roberts-Austen says that the provision of these curves has already enabled notable economy to be effected in this important branch of metallurgy.

Fig. 3



Professor Ewing exhibited several magnetic curve tracers, one of which is represented in Fig. 4. This instrument shows the magnetic quality of iron, steel or other magnetic metal, by exhibiting the curve which connects the magnetization, B, with the magnetizing force, H, in any magnetizing process. The curve is

exhibited upon a screen by the spot of light reflected from a mirror, which receives two components of motion. The vertical component is proportional to the magnetization, and the horizontal component to the magnetizing force. The instrument is shown in Fig. 4,

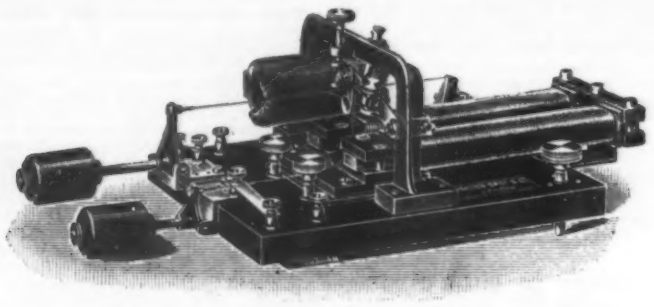
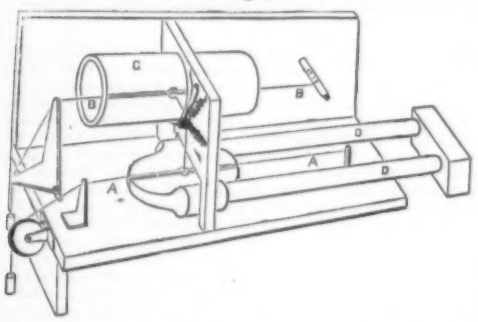


FIG. 4.

and Fig. 5 is a diagram showing the functions of the various parts. The mirror is pivoted upon a single needle point, which leaves it free to turn both ways, and it is connected by threads to the middle of two stretched wires, A A and B B, in such a manner that when either of the wires sags the mirror suffers a corresponding deflection. The threads are kept taut by light springs, the tension of which is adjustable. The wires are stretched in narrow slots, forming gaps in two magnetic circuits, D D and C. One of these circuits, D D, is made up of the iron or steel to be examined, along with suitable pole-pieces and yoke, and the current which passes through the magnetizing coils of this circuit passes also through the stretched wire, B B, in the gap of the other magnet. The other magnet is constantly magnetized by a steady current, and a steady current also flows through the stretched

Fig. 5

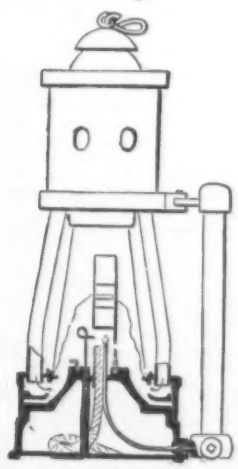


wire, A A. Hence, when the magnetizing current of D D is altered, the wire, B B, sags out or in, and gives horizontal motion to the mirror proportional to the magnetizing force acting on D D. And when the magnetism of D D is altered, the wire, A A, sags up or down, giving vertical motions to the mirror proportional to the changes of magnetism.

The samples to be tested form the arms of D D. They may be solid rods, or rods built up of thin strips, or of wire. The rods supplied with the instrument are of soft sheet iron, built up of insulated strips, with a net cross section about one inch by half an inch, and about 18 inches long. In preparing other rods for comparison of magnetic quality, the same dimensions are to be chosen as those of the standard rods. Clamps are provided at the pole-pieces to allow the rods to be readily inserted and removed.

Professor Frank Clowes exhibited a lamp for the detection and estimation of small proportions of fire-damp, petroleum vapor and other inflammable gases or vapors in the air. A sectional drawing of it is given in Fig. 6. The vertical part of the handle, which can

Fig. 6



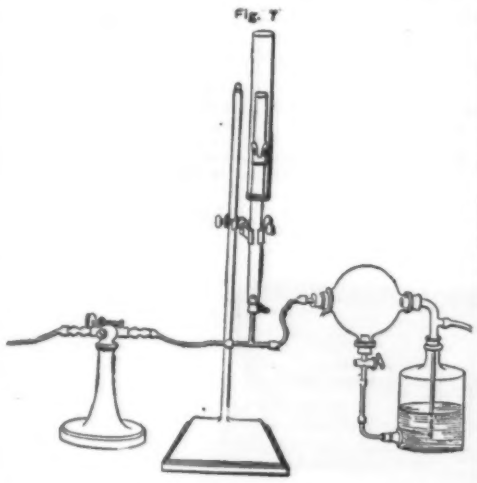
readily be attached to and detached from the lamp, is a little steel cylinder containing compressed hydrogen; this cylinder is charged when necessary from a larger store bottle. When charged at 100 atmospheres pressure, it furnishes the standard 10 mm. flame, burning continuously for about 40 minutes. This is an ample supply of hydrogen for inspection of a mine, since the hydrogen flame would only be used occasionally, and then for very short intervals only. If a longer service is required, a cylinder of the same diameter, but of greater length, and of capacity half as great again, may be adapted to the lamp. Or one or more reserve cylinders can be easily carried in the pocket. The small cylinder may be charged sufficiently for use several hundred times from a large cylinder under 120 atmospheres pressure.

Ashworth's modified lamp is used in connection with this invention. When used for testing in a mine, after the hydrogen has been ignited by the ordinary flame, the lamp wick is drawn down, the hydrogen flame is adjusted to a particular level, and a cap is looked for over the flame; the inventor claims that this standard flame will readily indicate and measure percentages varying from 0·25 to 3, and by giving such delicate indications let the managers know when they ought to blow more air through the mine.

The Rev. Frederick J. Smith, M.A., exhibited some curious photographs, produced by placing coins, medals and such-like objects on a sensitive plate; an electrical discharge was sent through the object, and a developer then applied to the film, whereby images of the designs upon the objects were obtained. The best results were obtained in oxygen; no results could be obtained in a good vacuum; changes of temperature made little difference in the results; increase of atmospheric pressure was found to improve definition.

Professor A. Smithells exhibited some experiments to demonstrate the structure of flames. The arrangement represented in Fig. 7 is practically a large Bun-

Fig. 7



sen's burner made of glass, with common air and coal-gas admitted under carefully regulated pressures. The air was sent through a spray-producer containing chloride of copper, so that some of the latter should be carried up to the flame. By careful regulation the flame was then divided into two parts, the one part burning at the top of the inner tube, and the other part burning at the top of the outer tube; all the green light was in the latter, which seems to show that oxygen is necessary to enable the characteristic spectrum of copper to appear, a point about which there is some contention.

Perhaps the most striking experiments exhibited during the evening were those by Mr. A. A. C. Swinton on the lines originated by Tesla. The filament of an ordinary 5 c. p. 100-volt lamp was caused to incandesce with current conveyed through the human body; the filament then gave out a yellowish light. Sparks, evidencing a difference of potential of some thousands of volts, were produced between the two hands of the same operator. A luminous spiral was produced in an exhausted glass tube by molecular bombardment from a wire spiral wound outside the tube. Some effects produced by high frequency discharges passing through semi-conducting substances and striking liquids, were also exhibited.

Professor Marshall Ward, by the aid of the electric lantern, exhibited upon the screen some photomicrographs illustrating the action of solar and electric light on the spores of bacteria and fungi. The action of strong light is to kill them when the exposure is long enough, amounting in some cases to about two hours, and the blue rays are most powerful in producing the effect; the less refrangible waves of the spectrum have little influence in the matter.

For a long time it has been known that an alloy of sodium and potassium is liquid at ordinary temperatures, and Mr. E. C. C. Baly and Mr. J. C. Chorley have taken advantage of the fact to use this alloy in thermometers, with a trace of nitrogen in the vacuum. Their range is from 0 deg. to 620 deg. C. (1,150 deg. Fah.); specially hard glass is used in their construction; it softens at about 650 deg. C.

Captain Abney and General Festing gave some experiments on the extinction of light and color. Professor C. V. Boys exhibited appliances for setting out curves. Sir J. B. Lawes and Dr. J. H. Gilbert gave information as to the effect of organic and inorganic manures upon the growth of turnips, and many particulars about their farm at Rothamsted. Mr. H. A. Miers exhibited goniometers and other instruments for the study of crystals. Professor Rucker and Professor Thorpe displayed maps showing the forms of the true lines of equal declination, equal horizontal force, and equal dip in the United Kingdom, for the epoch January 1, 1891. Mr. Carus-Wilson exhibited an appliance for enabling lecturers to demonstrate with chalks in a darkened room. Mr. H. L. Callender, M.A., exhibited some useful and carefully compensated electrical and meteorological instruments. Dr. Hugh R. Mill placed on view a series of sections illustrating the seasonal distribution of temperature in sea-water lochs.

Major Holden, R.A., exhibited the following electrical apparatus: (1) Apparatus for indicating and recording the electrical pressure and current on alternating systems of supply, effected by a new method of showing the expansion of a wire or number of wires, which are heated and elongate during the time that the electric current is passing. (2) Instrument for rapidly ascertaining the E. M. F. and internal resistance of a galvanic cell. By means of a small portable voltmeter, the difference of potential at the terminals of the cell under two different conditions of external resistance is rapidly measured, and from these results the E. M. F. and internal resistance are found by a diagram or from a table. (3) Self-recording pyrometer working with Le Chatelier's thermo-couple. This apparatus registers the temperature of a furnace, with pen and ink, on a revolving drum covered with paper.

Professor W. N. Hartley placed on view some photographs of the spectra of the flame from a Bessemer converter. Mr. J. Norman Lockyer exhibited the photographic spectra of some of the brighter stars. Mr. Isaac Roberts exhibited five original negatives of nebulæ and clusters of stars taken with his 20 in. reflector. Mr. W. R. Topley and Mr. R. Kerr exhibited maps and photographs illustrating the Sandgate landslip. Mr. E. Matthey exhibited specimens of the form in which antimony separates from bismuth, at a temperature of 350 deg. C. Dr. G. Gore exhibited two compact voltaic batteries of zinc and platinum. Major P. A. McMahon demonstrated a new method of obtaining designs for tessellated pavements. Mr. E. Wethered exhibited on the screen some photographs of micro-organisms in limestone rocks, and Lord Armstrong performed some experiments to show the nature of the electric discharge in air and water. Other objects on view related to such subjects as entomology, zoology and anatomy.

THE MANUFACTURE OF VEGETABLE OILS.

SOME interesting particulars concerning the preparation of vegetable oils are given in the consular report of Consul Trail, of Marseilles. The report states, as is already well known, that from the remotest antiquity Marseilles has been the emporium not only of the oils of the province, but also of those produced by Italy, Spain, the African coast, Greece, and Turkey.

In addition to the extensive olive yards which abound in the neighborhood of Marseilles, considerable quantities of seeds are imported, from which the oils are obtained. The chief item among the seeds, etc., imported is peanuts, which are mostly imported ready shelled. Afterward, in order of importance, as shown by the quantity imported, come cocoanuts, palm nuts, sesame from India and Africa, cotton seed, rape seed, sesame from Levant, and, lastly, linseed.

PROCESS OF MANUFACTURE.

In the system of presses at present in use in Marseilles, the following is the process of manufacture: The seeds are first put in a mill, where they are thoroughly triturated by means of two upright stones or rollers, the object of this process being to allow the oil to be more readily expressed. The seed so crushed is then divided into several flexible sacks or baskets made of esparto grass and horsehair, and called in French "scourtins," and these are placed one under another, with plates of iron between them, in the press. When pressure is applied the oil forces its way through the baskets and flows down the exterior surface into a receptacle below the press for the purpose of receiving it. Often before the pressing is terminated the action of the press has to be stopped, owing to some of the scourtins being pressed more on one side than on the other, so that they have to be readjusted before the operation can be continued.

Care, moreover, has to be taken not to exceed a pressure of about 250 kilos. per square centimeter, equal, roughly, to 31¾ cwts. per square inch, as the scourtins will burst if strained to a higher extent.

The methods adopted for the extraction of the oils from the various seeds, nuts, etc., are as follows:

SESAME.

Levant Sesame.—This is subjected to three pressings, the seed being cold in the first two, but heated for the third, in order to allow of more oil being extracted. Before being pressed at all the seed is thoroughly triturated, to allow the oil to come away more readily under pressure. In the first pressing from 30 to 32 per cent. of oil is obtained, and this oil is sold at from 90 to 96 francs per 100 kilos. for table consumption. The seed is now thoroughly triturated again, a little water —about one or two per cent.—being added, and, being again put under pressure, yields from nine to ten per cent. of oil of a quality slightly inferior to the first, but which is still quite good enough for eating purposes. The price of this oil varies from 70 to 73 francs per 100 kilos.

After being removed from the press the seed is once more thoroughly triturated, and from two to four per cent. of water is added to it, after which it is heated to a temperature of from 70° to 80° C. The oil that now comes away is of very inferior quality to that obtained by the first two pressings, and in quantity is from 10 to 11 per cent. of the weight of seed originally put into the press. This oil is sold at from 49 to 51 francs per 100 kilos., and is used in the manufacture of soap. The residuum is made into oil cakes, which are used for feeding cattle, and are sold at from 12 to 13 francs per 100 kilos. The cost of transporting this seed to Marseilles is from 10 to 15 francs per ton of 1,000 kilos.

Indian and African Sesame.—This seed, like the sesame from the Levant, is subjected to three pressings, in the first two of which the seed is cold and in the

third heated. The oil yielded in the first pressing is not so great as in the former quality of seed, the amount being from 27 to 28 per cent. of the weight of seed pressed; and it is greatly inferior in quality, being sold at from 62 to 75 francs per 100 kilos. It is used, according to quality, either for table purposes or for lamp oil.

After being triturated again, and having from one to two per cent of water added, the seed is again pressed, and yields from nine to ten per cent. of oil of a quality slightly inferior to the first, and which, like it, is destined either for eating purposes or lamp consumption. The oil is sold at prices ranging from 60 to 62 francs per 100 kilos.

SHELLED PEANUTS.

These nuts are subjected to two pressings, the seed being first triturated and then heated to between 70° and 80° C. It is to be noted that the treatment of this product differs from that to which the sesame is subjected, in that peanuts are not pressed cold at all, but have to be heated even for the first pressing.

The yield of oil arising from the first pressing is about 50 per cent. of the seed crushed. It is used in the manufacture of soap, and also for lubricating purposes, and is sold at the rate of 50 francs per 100 kilos.

POPPY SEED.

Poppy seed is pressed twice cold and then heated and pressed once more. The seed is first thoroughly triturated, and yields in the first pressing 22 per cent. of its weight in oil. This oil is worth 72 francs per 100 kilos., and is used for table purposes and also to a very considerable extent in the manufacture of fine paints. After being crushed a second time and having one or two per cent. of water added, the seed is pressed again, when 10 per cent. more oil is obtained, which is used, like the first, for table purposes and for making oil paints, and also for burning. This oil sells at 60 francs per 100 kilos. The seed being crushed again, mixed with about three per cent. of its weight of water and heated to a temperature of from 70° to 80° C., yields in the third pressing seven per cent. of its weight in oil, which is used almost exclusively in the manufacture of soap, and is sold at 50 francs per 100 kilos.

The residuum is made into oil cake and is sold at 11 to 11·50 francs per 100 kilos. This oil cake is used for fertilizing purposes. The cost of shipping this seed to Marseilles is from 30 to 35 francs per ton of 1,000 kilos.

LINSEED.

Linseed is subjected to two pressings, in the first of which the seed is cold and in the second heated. The yield of oil in the first pressing is 22 per cent. of the weight of the seed, and the oil obtained is used for table purposes, being sold at from 62 to 63 francs per 100 kilos. After being triturated a second time—it having been triturated as usual before the first pressing—the seed receives the usual addition of about two per cent. of its weight of water, and is heated to a temperature of from 70° to 80° C., and is afterward again placed in the press, when it yields ten per cent. of its weight in oil of an inferior quality, which is chiefly used in the manufacture of soap. The residuum is made into oil cakes, which are of superior quality to those produced in the pressing of any other kind of seed. They are used for feeding cattle, and are sold at from 16 to 17 francs per 100 kilos. The cost of transporting linseed to Marseilles is from 30 to 35 francs per ton of 1,000 kilos.

CULTIVATED RAPE SEED.

This seed is pressed twice, once cold and once heated. It is in the first place thoroughly triturated. The first pressing affords 22 per cent. of oil, which is sold at the rate of 65 francs per 100 kilos. for lamp oil. After being mixed with from two to four per cent. of water and heated to 70° or 80° C., 12 or 13 per cent. of oil of an inferior quality is extracted, which is used in the manufacture of soap, and is sold at 50 francs per 100 kilos.

Oil cake is made from the residuum, and is sold for feeding cattle at ten francs per 100 kilos. The cost of importing rape seed at Marseilles from the countries where it is grown is from 30 to 35 francs per ton of 1,000 kilos.

WILD RAPE SEED.

Wild rape seed is triturated and heated before being put under the press. The first pressing results in a yield of about 14 per cent. of oil, which is sold for mixing purposes at the rate of 53 to 54 francs per 100 kilos. The second pressing, after the usual trituration, addition of two to four per cent. of water, and reheating to 70° or 80° C., gives forth eight per cent. of oil in addition, which, being of slightly inferior quality to the oil first obtained, is sold at 50 francs per 100 kilos. and is used for making soap.

As in the case of most of the other oils mentioned in this report, the residuum goes to make oil cake, which is used as a fertilizer.

This seed does not cost so much for transportation as those hitherto mentioned (sesame from the Levant excepted). It is shipped to Marseilles at a cost varying between 20 and 25 francs per ton of 1,000 kilos.

CASTOR BEANS.

Castor beans are subjected to two pressings, after being first thoroughly triturated. In the first pressing the seed is cold, and the yield obtained is about thirty per cent. of the weight of the seed. This oil, which is used extensively for medicinal purposes, is sold at an average price of 65 francs per 100 kilos. The seed, being triturated, watered and heated, as described above, yields in the second pressing from eight to ten per cent. of an oil inferior to that first obtained, and is sold at 58 francs per 100 kilos. This oil is generally used for lubricating machinery.

The residuum is formed into oil cakes, which are used for fertilizing purposes, and are sold at from 9 to 9·50 francs per 100 kilos.

The cost of transportation to Marseilles is from 30 to 35 francs per ton of 1,000 kilos.

EGYPTIAN COTTON SEED.

This seed is thoroughly triturated and then pressed twice. In the first pressing it is cold, and it yields from 10 to 12 per cent. of its weight in oil. This oil is destined for table purposes, and especially for mixing with olive oil, as it is perfectly tasteless; and for this reason many people also avail themselves of it for frying. It is sold at from 80 to 90 francs per 100 kilos.

The oil—from eight to ten per cent. of the seed in quantity—obtained in the second pressing, after the usual regrinding, watering and heating, is of very inferior quality, and does not bring a higher price than about 50 francs per 100 kilos. It is out of the question to use this oil for eating purposes (nor can any of the *huiles à fabrique*, or oils obtained after the seed has been heated, be used for this purpose), and it is accordingly utilized for the manufacture of soap.

The residuum is made into oil cakes, which are sold at 10 francs per 100 kilos. for feeding cattle and for fertilizing purposes.

The charges for the importation of Egyptian cotton seed into Marseilles are very low, not being above ten to eleven francs per ton of 1,000 kilos.

NIGER.

Niger is first triturated and then pressed cold. The yield is about 18 per cent. of the weight of the seed, and the oil so obtained is sold at an average price of about 65 francs per 100 kilos. for mixing purposes.

After being reground, watered and heated, as before described, a further yield of 14 per cent. is obtained, the oil which comes away being used for soap making, for which purpose it is sold at 50 francs per 100 kilos.

The residuum, as in the case of the other seeds, is made into oil cakes, which are sold as fertilizers for about 9½ francs per 100 kilos.

PULGHERIA.

After trituration it is heated before being pressed. The first pressing results in a yield of 20 per cent. of oil, which is used in the manufacture of soap. After being triturated again, and then watered and heated as usual, 10 to 12 per cent. more oil is obtained, which is nearly as good as the first, and is destined for the same use. The cost of the oil of the first pressing is 53 francs, and that of the second from 52 to 53 francs per 100 kilos.

It will be noticed that when seed is not pressed cold at all, but is heated for both the first and second pressings, the values of the oils resulting from both these are nearly the same.

The residuum is made into oil cakes, which are used as a fertilizer.

COCOANUTS.

Cocoanuts are pressed twice, being heated and triturated for each pressing. The total yield of oil is from 62 to 64 per cent., and it is sold for soap making at a cost of from 45 to 48 francs per 100 kilos.

The residuum is made into oil cakes, which are sold as food for cattle at a cost of 11 to 13 francs per 100 kilos.

PALM NUTS.

Palm nuts are pressed twice, being triturated and heated for each pressing. The total yield is from 38 to 42 per cent. of the weight of nuts pressed, and the oil is sold at 50 francs per 100 kilos., and is used solely in the manufacture of soaps.

The residuum is made into oil cakes of an inferior quality, which are used as food for pigs.

MOWRAH.

This seed is treated with two pressings, and has to be triturated and heated each time before being pressed. The total quantity of oil obtained is from 37 to 41 per cent. of the weight of seed pressed, and is sold at the rate of 55 to 60 francs per 100 kilos. for the manufacture of stearin.

The residuum is made into oil cakes, which are of a poor quality, and are sold at 3 to 4 francs per 100 kilos. for manure.

LOSSES IN SUGAR MAKING.

THE enormous losses of sugar in process of manufacture became apparent in Louisiana when chemical control of the manufacture was first begun. As the commercial world was willing to buy and sell sugar produce on its polariscopic test, it became evident that by this same means the amount of actual sugar entering our sugar houses could be determined. As cane juice extraction was largely a matter of mechanical skill and depended upon the strength of the factory's machinery, as well as upon the engineering skill in utilizing the whole capacity of the juice-extracting machinery, chemical control begun with the juice extracted, determining the crystallizable sugar in the juice with as great certainty as the public weigher determines the sugar in any package passing under his scale beam.

This sugar in the raw cane juice then entering into the process of clarification, evaporation, concentration and centrifugaling, was found in more or less reduced quantities in the sugar turned out at the centrifugal machines and in the first molasses. The losses were so great as to attract and to demand attention.

The determination of the crystallizable sugar in that turned out at the machines and the determination of the crystallizable sugar in the molasses gave the same data as that used in the commercial world on which to buy and sell the world's crop of sugar.

Omitting for the present the reboiling of our molasses for the manufacture of second sugar therefrom, we may divide our process of sugar manufacture into four parts:

1. Juice extraction.
2. Juice clarification.
3. Juice evaporation and sirup production.
4. Sirup concentration and sugar production.

Omitting the consideration of the losses in juice extraction and determining the sucrose in the juice extracted and with which we begin our process, immense losses were found to occur during juice clarification. These losses reached 5 to 10 per cent. of all the sucrose found in the juice, and once satisfactorily determined led to the quick adoption of filter presses for the utilization of the scums, until now there is scarcely a sugar house in Louisiana getting a good yield that has not filter presses as necessary means to proper and economical juice clarification. There are now no washouts in our best houses; all the scums and washings go to the filter presses, and nothing but dry filter cake now comes from the cane juice. This cake or mud, reaching about 1 per cent. of the weight of the juice, would reduce the total quantity of raw material sent through the factory 1 per cent., and as filter cake ordinarily tests for sucrose nearly as high as cane juice, except in the few instances where the cakes are well washed, we have here in the process of clarification a loss of about 1 per cent. of our sugar still continuing in most of our best houses.

The juice once clarified, its evaporation into sirup becomes one of the most serious incidents of our industry, during which *entrainment* occurs, resulting in losses of from ½ per cent. to 12 per cent. of the whole, and losses that seem thus far practically unavoidable, and to prevent which many evaporating apparatuses, many catchalls, baffle plates, slow-downs, etc., have been invented.

The determination of the sucrose in the raw juice and the deduction therefrom of the sucrose in the filter cake furnish undisputed data as to the amount of sucrose with which the process of evaporation is begun. This assumes that there will be no visible mechanical losses, such as leakages, overflows, etc., and no inversion.

If there be any of these, then to definitely determine entrainment, the sucrose in the clarified juice entering the evaporating pans must be determined.

The sucrose in the juice entering into evaporation being determined, the sucrose in the sirup discharged from the evaporating train is determined, and any difference represents the loss which may come from inversion, overflows or entrainment. Inversion is readily determinable, and in many houses is now entirely avoided. Overflows are presumed to come from carelessness, negligence, ignorance or accident, and seem to be avoidable. We are now left with the chief loss in our sugar houses after the juice extraction, and that is entrainment during evaporation, and we believe it not extravagant to assume this loss in Louisiana to-day at 5 per cent. where multiple effect evaporation is used.

Entrainment is not well understood. It is frequently confounded with mechanical overflows or with foaming up, or priming, as does dirty water in steam boilers. The familiar soap bubble is an instance of entrainment. They are so light as to float away in the open air without the vortex and suction of a vapor outlet as in our ordinary evaporating trains. Soap bubbles are made possible by the viscosity of the soapy water and the tension of their contained air. Formulæ have been furnished for soap bubble solutions, such as caustic soda, oleic acid and glycerine, to be mixed in proper proportions with water. The viscosity of the solution is all that is needed to enable the wonderful experimentation that has been had with soap bubbles.

Cane juice is always more or less viscous. You may bathe your hands in bay rum and wipe them dry and clean; you may bathe your hands in cane juice, but they cannot be wiped dry and clean. The material is too viscous and must have its viscosity reduced by water. Cane juice in evaporation has its viscosity increased, and entrainment seems to increase with the increasing density of the sirup in process of evaporation.

Those who have observed the evaporation of cane juice in open evaporators have often seen the whole mass arise and flow over into the scum trough. This came from the application of a limited amount of heat. With more heat, violent boiling at a low level would begin.

The slow boiling seems to give full play to the viscosity of the liquid. The bubbles form, pile up on each other and overflow, while with high heat the vapor of water under high tension rises as a bubble through the mass of liquid, its surrounding thin film of viscous liquid exploding from the tension of the vapor when the bubble reaches the surface.

There is then no overflow, but the thin sides of bursted bubbles fly up into the vapor space of the apparatus and are cycloned off with the waste water. These losses are not visible to the eye, and are rarely perceptible by chemical test, because of the vast quantity of condensing water used.

They can never be entirely avoided, for as fogs float in the air, and salt sea air is felt and influences vegetation far inland, so these little globules of cane juice and vapor and the particles of larger broken globules float up in our evaporating pans until they reach the fatal outlet and are carried off with the waste waters.

It is said that entrainment occurs chiefly, if not almost entirely, in the so-called sirup pan of our multiple effects, the last pan, that in which the liquid is of highest density, of highest viscosity and requiring vapor of high tension to effect circulation and ebullition; that if we boil our sirup to but 20 or 25 deg. Baume, we shall have less entrainment than if we boil to 30 deg.

This does seem logical, and would doubtless give us more sucrose in our sirup, less loss during evaporation by entrainment, but it would seem to leave the work to be done by the vacuum pan and to promote the losses by entrainment there. This phase of the problem has not been much worked out thus far.

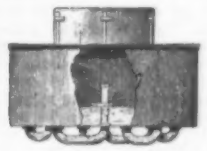
It is said that in Europe the standard multiple effects are rated at but half the evaporating capacity we estimate here for a given heating surface, and their apparatuses generally have more top or vapor space than we ordinarily have.

Several of our prominent planters are now improving their present apparatus by increasing the vapor space, endeavoring by large space to enable gravity to overcome entrainment.—*La. Planter.*

GALVANIZING IRON AND STEEL.—W. K. Greenway, Bradley.—The pot or vessel containing the galvanizing metal is either placed in a larger vessel or is constructed with two walls, one within the other, with a convenient space between them. Molten lead or other metal with a lower melting point than zinc is placed in this intervening space and transmits the heat from the fire on the outside to the metal in the inner bath. By this means the burning of the galvanizing metal is prevented, the loss of heat reduced, and the pots made more lasting.

HOW CIGARS ARE MADE IN FRANCE.

IT has been calculated that it takes three years and four months to make a pinch of snuff. And there is no exaggeration in the calculation, for the leaf of tobacco designed to be reduced into powder and do the honors of the snuff box remains eight months in the store houses of the administration of tobaccos, and then, after being introduced into the manufactories, it is chopped up and submitted to a fermentation that lasts six months. After being pulverized, it is allowed to stay four months in cases, and, finally, is kept two months in casks before being delivered to consumers.



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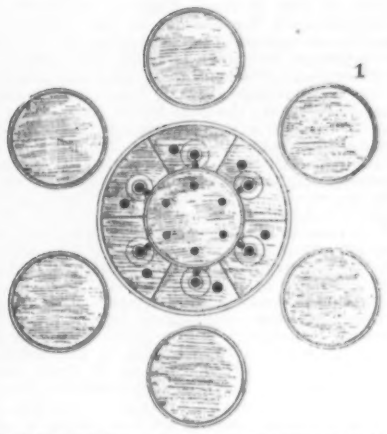

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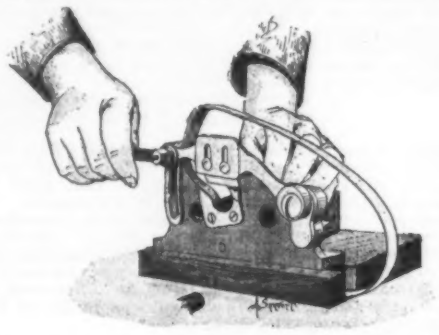
ARRANGEMENT OF MACERATING VATS.

Although the period of gestation, so to speak, of the cigar is shorter, it too has to undergo a series of transformations, the most important of which consist in the mixtures of tobacco and a methodical washing. When we enter a manufactory of the adminstration the first thing that strikes us is the accumulation of tobacco leaves in the sheds. In the stocks of *manoques* that are piled up therein are found specimens of the principal tobaccos of the world. These are designed to be mixed according to formulas rigorously determined for each brand of cigar.

At the Reuilly factory, which alone in France works Havana tobacco, the bales are stored up in vast, well ventilated cellars, in which they are as well protected as possible against all variations of temperature, which, by bringing about successive fermentations, would interfere with their proper state of preservation. The one-cent cigars are composed of 42 per cent. of French tobacco, 40 per cent. of Kentucky, 5 per cent. of Hungarian, 7 per cent. of Alsatian, and 6 per cent. of Algerian. The same sorts, but in different proportions, enter into the composition of the two-for-three-cents cigars. The two-cent cigars have a filling of pure Brazilian or a mixture of Brazilian and Rio Grande, and the wrapper is of Java or Sumatra or even of Brazilian tobacco. These proportions, rigorously determined in theory, are quite difficult to observe in practice. The manufacture of a cigar requires a certain rapidity, and it would ill accommodate itself to a work that, while consuming time, would be always imperfect. The result would be very marked inequalities in the quality and flavor of cigars of the same price. Now the administration has always been very desirous of establishing as great a uniformity as possible in the flavor of cigars of the same quality. To obtain this, it formerly had recourse to a maceration of the leaves. This is an operation that consists in placing in the same bath the tobaccos of different kinds that are to enter into the manufacture of cigars of the same category. This bath brings about a certain homogeneousness between the species. It causes a portion of the substances contained in the leaf cells to dissolve, and there then occurs an exchange between the principles inclosed in the cells and those that the juices contain. Such leaves, for example, as are deficient in potassa and have an excess of lime salts absorb potassa and lose a portion of the lime salts. In theory, this seems very simple, doesn't it? When it has been a question of applying the principle of maceration, a host of imperfections have had to be contended with.

After some experiments by Mr. Schloesing, a methodical washing has been adopted. Such washing is based upon a principle which, by its simplicity, recalls Columbus' theory of the equilibrium of the egg.

If we leave a certain quantity of tobacco immersed in water for several hours we obtain tobacco juice. If, afterward, we immerse fresh tobaccos anew in this juice, we obtain a more concentrated juice after a certain length of time, and, on continuing thus, we obtain juices whose strength goes on increasing. If, on another hand, the tobacco that has been submitted to maceration is immersed anew in pure water, it loses its strength, and several similar macerations exhaust it more and more. It is easy to imagine a series of six vats in which such macerations are effected, the first containing fresh tobacco immersed in concentrated juice, the last containing strong tobacco immersed in water, and the others containing juices of intermediate states.

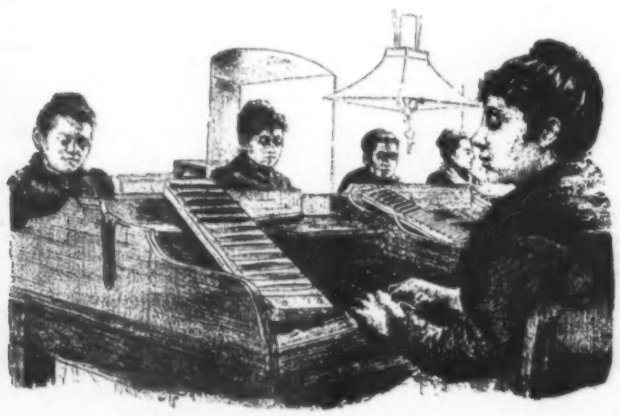


MACHINE FOR CUTTING CIGARS TO THE PROPER LENGTH.

This principle once laid down, the engineers of the manufactories set about to simplify the operations that the methodical washing involved. It was apparently a pretty difficult problem. However, the manufactories soon came into possession of a new machine that solved the problem in a manner that was as practical as it was original. Thanks to the apparatus invented by Mr. Letixerant, slightly modified by Mr. Belhomme, it is no longer necessary to shift the leaves six times, but it is the juices that are shifted. From the macerating vats they are led into a central vat in which the tobaccos are placed. The condition so actively sought by the administration to render the flavor of cigars uniform has therefore been realized.

UNPACKING THE MANOQUES.

The question that arises is to know whether this truly improves the average flavor of the leaves thus washed, or whether, on the contrary, the aromatic principles of the tobacco are not altered by their solution in water. Opinions appear to-day to be divided, and the methodical washing has been abandoned in several manufactories.

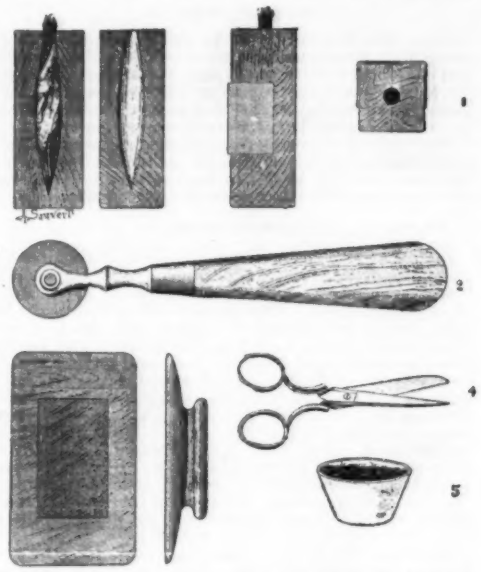


CIGAR MAKERS AT WORK.

But the leaves are only in their first stage. Before being distributed to the cigar makers, they have a voyage to make around the manufactory. Some, however, on account of their fineness and their quality, do not undergo this first test. They are slightly moistened and afterward dried upon hurdles. Thus are treated the leaves that are designed to serve as wrappers. The others, those that come from the vat, go to a drier. This is the second stage. After the drier has done its work, they are united in masses of 600 to 1,000 pounds, and are allowed to ferment for twenty days at a temperature that varies between 30 and 28 degrees. This is the third stage.

This time, the leaves, after this last stage, pass from the ground floor to the first story, where the cigar makers' rooms are generally situated. They are distributed among the operatives, who align them, spread them out and proceed to sort them, carefully separating from among the leaves designed for making wrappers those that appear to them too thin, those that contain too many rust spots, or the too dark color of which indicates little incombustibility.

The sorting finished, they are ready to be worked.



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TOOLS EMPLOYED IN THE MANUFACTURE OF CIGARS.

1. Cigar moulds. 2. Tool for cutting leaves. 3. Polisher. 4. Scissors for shaping the points of cigars. 5. Paste pot.

A good female cigar maker can manufacture 300 two-cent and from 500 to 600 one-cent cigars a day. It may, therefore, be calculated that they make one cigar per minute per day of ten hours. But this figure is reached only by first-class operatives. The rapidity with which they work is excessive. From the small pile of twisted leaves within reach of their hand, they take some fragments and press and unite them. This gives what is called the filler. A leaf quickly rolled into a cylinder around the latter holds it. This is called the binder. It now only remains to put on the wrapper. This is the most delicate operation. The operative takes a selected leaf from another pile, winds it around the binder, and fastens it by means of a paste composed of starch or dextrine colored with chiccory or tobacco juice, and the small contingent of cigars accumulated in front of her increases by a new unit.

But, in the manner of crumpling and assembling the first fragments and retaining them by the binder and wrapping the cigar, there is a whole art. The observation of the rules necessary to make a cigar that can be smoked is more difficult than might be thought, and necessitates a long apprenticeship. The first cigars laboriously elaborated by tyros are too loose or too hard, or else they present vacuities in places or have not the required weight, and all such defects cause them to be rejected by the women whose business it is to inspect the work.

These inspectors generally have a very practiced eye, and it is rare that a defective cigar escapes them. They immediately throw it out and give it a slight twist, so that it shall no longer be possible to replace it among the cigars accepted.

The cigars are cut to the regulation length either directly by the cigar maker or by means of a machine.

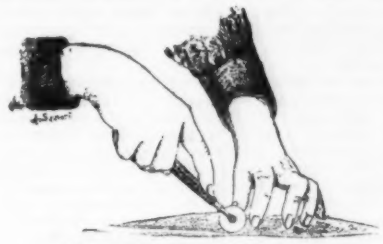
Once finished and received, the cigars are sent to the drier. The driers consist of small, long cases quite similar to cigar boxes. Herein they gradually lose the humidity with which they are still impregnated. They usually pass from fifteen days to a month in the drier. It is certainly a sufficient period, but it is the minimum of the time requisite. Nearly an entire year would be necessary to obtain perfect cigars.

WETTING THE TOBACCO LEAVES.

The Havana cigars manufactured at Reuilly are submitted to a drying at a low temperature strictly necessary to assure their preservation in boxes. On coming from the drier they are sorted out and divided into *claros*, *colorados* and *maduros*, according to the color of the wrapper.

It is useless to say that the manufacture of high-priced cigars scarcely resembles that of one or two

cent ones. The rapidity of manufacture here has certainly its importance, but it is a question before everything else of delivering an irreproachable cigar. Although a skillful operative working on one-cent cigars can deliver 600 of these a day, an excellent operative can manufacture scarcely more than from 150 to 200 Trabucos in ten hours. Not only must the cigar have all the qualities to permit of its being easily smoked, but its form must be very perfect. So the cigars called superior are made in moulds. These moulds consist of two hollow parts, each of which is capable of containing half of a cigar, and which may be united by a metallic clasp. The fillers of the cigars, that



CUTTING THE WRAPPER.

MANNER OF WRAPPING THE CIGAR.

SMOOTHING THE CIGAR.

must be made very pliable, are inclosed in the binder and the whole is slightly compressed in the mould, wherein it is turned over at the end of a few hours. The moulds generally remain for about half a day in a ventilated and heated room. The material is then removed from them and provided with a wrapper. The advantage of this method of manufacture, which permits of employing relatively dry leaves for the interiors, is that it gives smooth and very regular cigars whose appearance pleases many smokers.

An endeavor, too, has been made, but without success, to manufacture cigars mechanically. The products obtained are too hard and are smoked with difficulty.

The Havana cigars manufactured in France are classified as follows:

Of pure Havana: Cazadores chicos, Trabucos finos, Aromaticos, Operas.

With Havana fillers only: Londres extra, Londres, Brevas, Camelias, Favoritas.

In 1857 the administration of tobaccos conceived the idea of manufacturing itself a portion of the cigars that it had been buying up till then from merchants of Havana. What decided it to do this was the reputation obtained by the Millares, a three-cent cigar which was then a new creation. The administration rightly said to itself that it would sensibly increase its profits if it manufactured the cigars itself from Havana leaf instead of buying them already made.

Hand work, in fact, is very dear in Havana, and the manufacturing is done there in a manner that is not very economical. The leaves are injured and wasted in the factories and much less work is done than in France. The buyer, therefore, has to suffer the consequences of such inconveniences, and it was a wise move to endeavor to avoid them. The administration since 1861 has regularly supplied itself from Havana with tobaccos grown in the best plantations of the island of Cuba, in the Vuelta-Abajo.

The Vuelta-Abajo, a region of about 160,000 acres, situated at sixty miles to the west of Havana, alone produces the most esteemed tobaccos, those that are designated at Havana by the name of *tabacos legitimos* (true tobaccos), and that the first class Havana manufactories employ to the exclusion of all others of Cuban production (tobaccos of Partidos or of Remedios). The region is therefore to tobacco what Medoc is to wine. All the land there is not of the same value. A few districts or *veguerios*, exhausted by an exaggerated production, have now lost their ancient reputation. The culture was formerly limited to choice lands generally formed of alluvial sand. Its progressive extension has naturally brought about a decrease in the average quality of the tobacco. The annual production of the Vuelta-Abajo may be estimated to-day at 250,000 bales or *tercios*, say 27,600,000 pounds, about a third of which is converted into cigars or cigarettes in the Havana manufactories. It will doubtless not appear useless to the reader if, before proceeding further, we say a word as to the successive manipulations to which the planter must submit his tobacco before baling it in tercios. It is, in fact, on the skill with which these are conducted that depends, for the most part, the final quality of the tobacco and its market value.

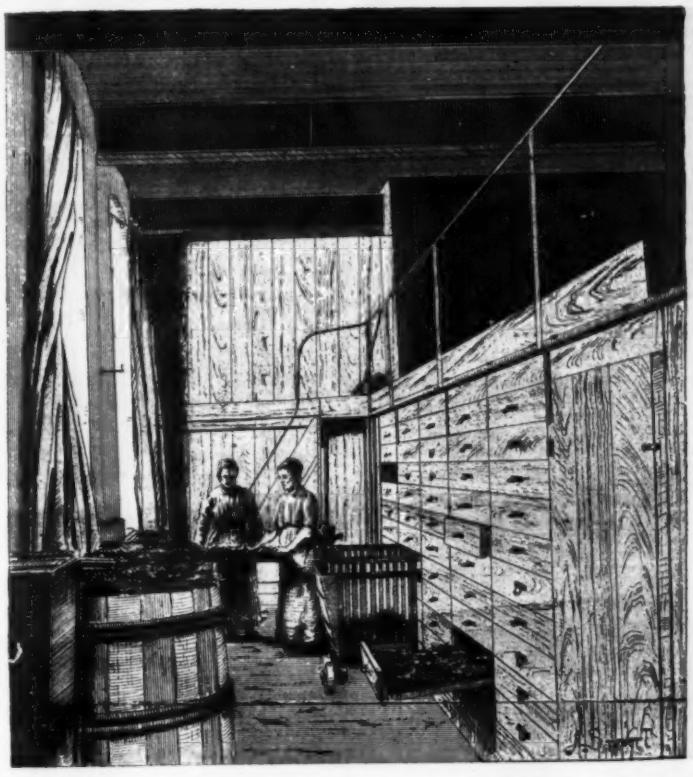
The first, after the gathering of the crop of from January to April, is the drying, which requires continuous precautions and surveillance. The second is the sorting or separation of the leaves, according to their size and the nature of their tissue, into 12 or 13 different classes. The third is the *betunage*. This operation, formerly peculiar to the Vuelta-Abajo, consists in fermenting, in more or less bulky masses, the leaves previously moistened with a liquid in fermentation called *betun*. This latter is a sort of tobacco juice obtained by digesting the ribs and debris of the leaves in pure water for eighteen days in the sun. Its preparation is a most delicate operation. A fermentation after betunage appears to be indispensable to the tobaccos of the Vuelta-Abajo in order to develop their aroma, while at the same time destroying the excess of nicotine with which they are habitually charged, especially in years of dryness. The leaves of the same category are afterward united in packages or *gavillas*, which themselves are grouped to the number of four to form a *manoque*. A bale or tercio consists of 80 manoques, and weighs about 110 pounds. These bales are sent on mule back from the interior of the country, where no wagon road exists, to the railway or boat that is to carry them to Havana.

The tobacco in bales, moreover, continues to ferment so much the longer in measure as its tissue is richer in gummy substances, generally from 3 to 5 months. It must not be used until after it has completely traversed this period of fever, which is perceptible both by the elevation of the temperature of the tobacco and the ammoniacal odor that disengages itself therefrom. The fine quality of the cigars made in Havana is not due solely to the growth of the tobacco, but also to the climatic conditions that accompany their manufacture. The climate of Havana, of a warm humidity, renders the manufacturer absolute master of the second fermentation in casks that the stripped leaves must undergo. Besides, it permits him to employ the tobacco at a degree of natural flexibility that could not otherwise be obtained without recourse to a thorough dampening beforehand that would alter the tissue more or less and, consequently, its quality.

Contrary to the general opinion, a good cigar is not formed entirely of tobacco derived from the same plantation. It is the most delicate task of the manufacturer to determine the mixture of tobaccos of different growths (generally three or four) that are to enter into the composition of his cigars. As with the wine merchant, this art of sorting demands on the part of the manufacturer a perfect knowledge of the qualities of the raw material and a delicacy of taste that is not very common.

The excellence of what is known as the "planter's cigar," elaborated at the very places of production, is still another legend to be destroyed. In France, as elsewhere, a vain attempt has been made to create for the manipulation of tobaccos an artificial medium recalling that which the climate of Havana furnishes naturally. The results have not responded to the cost of installation and supplementary hand work and have therefore not justified the risks of damage to which a too active artificial fermentation exposes the tobacco. It is, in definitive, toward a research for particular methods adapted to the climatological conditions of each country that manufacturers using Cuban tobaccos have had to direct their efforts.

In order to be employed, the leaves, on coming from



DRYING ROOM AT REUILLY.

CIGAR MAKERS' ROOM AT THE REUILLY MANUFACTORY.

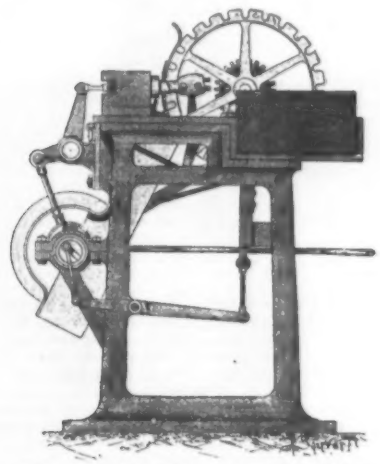
SEARCHING THE OPERATIVES AS THEY COME OUT OF THE FACTORY.

the bales stored in cellars or sheds, are moistened by immersion in pure water, to just a sufficient degree to give them the necessary flexibility. After a stay of twenty-four hours in a damp room, they pass to the stripping rooms, where at the same time is effected the sorting of the leaves into wrappers and fillers. The leaves for wrappers are immediately employed for the covering of cigars, as any delay in the use of them would injure the quality of their aroma and tissue. The leaves for fillers are freed from their excess of humidity in a drying room traversed by a current of air at a low temperature, and are afterward put into casks wherein they slowly undergo a fermentation analogous to that brought about by the Cuban manufacturers for developing the aroma and improving the flavor of tobaccos. It is only after the complete termination of such fermentation, often at the end of several months, that the tobaccos are fit for manufacturing purposes. All the Reuilly cigars are, as we have already stated, shaped in a mould and cut to the proper length by means of a special machine, after a little smoothing that equalizes the material. The cigar maker receives separately the leaves for wrappers and those for binders and fillers. She takes care to properly utilize these materials, and, particularly, to obtain the largest number of wrappers possible from the first category. These are cut into narrow strips of sizes and profiles that vary with the form of the cigar to be covered. They must have no prominent ribs, since these would spoil the cigar. The Cuban cigar makers do not proceed in the same way. They utilize the entire half-leaf as a wrapper, simply trimming its edges without ever cutting its ribs. This method, by reason of the manual dexterity that it requires and the diminution of material that accompanies it, is absolutely peculiar to the Cuban cigar makers. It consequently permits, by the simple inspection of a cigar, of surely telling whether or not it is of Havana make.

A knowledge of this peculiarity would allow lovers of smuggled cigars to recognize the fact that the majority of the cigars offered them are Havanese only in name and form.

The cigars, after being received one by one, are sent to the packing and boxing rooms, where they are first sorted out according to their colors, and afterward placed in cedar wood boxes.

In addition to the purchase of leaves, the mission of



GROUVILLE MACHINE FOR CUTTING OFF THE ENDS OF CHEAP CIGARS.

engineers, which the administration has maintained at Havana since 1861, occupies itself with the acquisition of cigars made in the first manufactories of the country. These cigars, designed to be sold singly or in the original boxes in the direct sales offices, and that have been met with for a few years past in small glass-covered boxes in a large number of ordinary shops, are shipped in boxes carefully lined with zinc and examined on their arrival by a committee of experts. The engineers who form this committee must not content themselves with verifying the appearance and state of preservation of the cigars, but are obliged to sample a specimen of each kind of cigar selected. As may be conceived, this is not the most agreeable part of the business, and it eventually causes in the samplers an absolute disgust for tobacco.

As well known, the samplers of Bordeaux wine, who pride themselves on their certainty of taste and long experience, boast of their ability to recognize the vintage of the wine tasted by them. The engineers whose duty it is to sample Havana cigars have reached identical results. The cigars received by the committee of experts are stored in closets that are protected as perfectly as possible against variations in temperature. The Havana manufactories which work the "legitimos" tobaccos of Vuelta-Abajo are sixty in number. They produce about two hundred million cigars, of an average price of five cents, which are exported about as follows: seventy millions to North America, fifty to England, twenty to Germany, fifteen to Spain, seven to France, and thirty-eight to other countries. Alone, among these manufactories, those of the first category, "Flor de Cuba," are called upon to furnish cigars to the French *Regie*.*

In addition to such manufactories, there are in Havana a hundred others that work Partidos tobaccos and produce about a hundred and fifty million cigars of an average price of about two cents. These cigars are especially exported to Germany, England and the United States. They are naturally almost always sold as "legitimos" cigars of Havana. The sums that the Regie devotes every year to the purchase of Havana tobaccos are very large. In 1889, it bought 6,960,000 Havana cigars that cost it about $400,000, and 94,770 pounds of leaves at a cost of about $70,000. It buys a certain number of cigars in the island of Manila. These are cheroots that spread out like the end of a trombone and that are sold at four cents. The prices obtained at Havana as well as in Manila afford a very nice profit. We may be convinced of this by comparing the prices given in the Regie's official catalogue with those that we take from the statistics of the directorship of the state manufactories. A thousand cigars stand the Regie in $57, and 100 pounds of leaves stand it in $76.

Now, for the cigars bought directly in Cuba, the prices fixed for consumers are, at a minimum, 66 and 76 cents per ten cigars. In fact, there are no boxes of ten cigars that are sold for less. In 1890, the state obtained from the sale of these Havana and Manila cigars $802,300, that is to say, nearly double the purchase price.

As for the cigars manufactured in France, the sum obtained from their sale that same year amounted to over $11,000,000, representing $3 per hundred of the total receipts of the monopoly. The tobacco industry, as may be seen, is on the full tide of prosperity.—*Le Magasin Pittoresque.*

* The department for the direct collection of public revenues by government employes, especially such as are founded upon a monopoly, like tobacco.

THE VELOCITY OF THE STARS.

MAN carries his head erect. Ovid claims that this attitude was given him in order to compel him to contemplate the heavens; but this does not mean that we are all poets, or are qualified to become astronomers, the profession being particularly difficult.

The wonderful equilibrium of those worlds distributed in innumerable numbers through boundless space seems a problem to the mysterious depths of which the vulgar, *profanum pecus*, cannot penetrate, but stops appalled upon the threshold of science. And yet, invincibly attracted, the human imagination, disturbed by so much immensity, incessantly rises toward

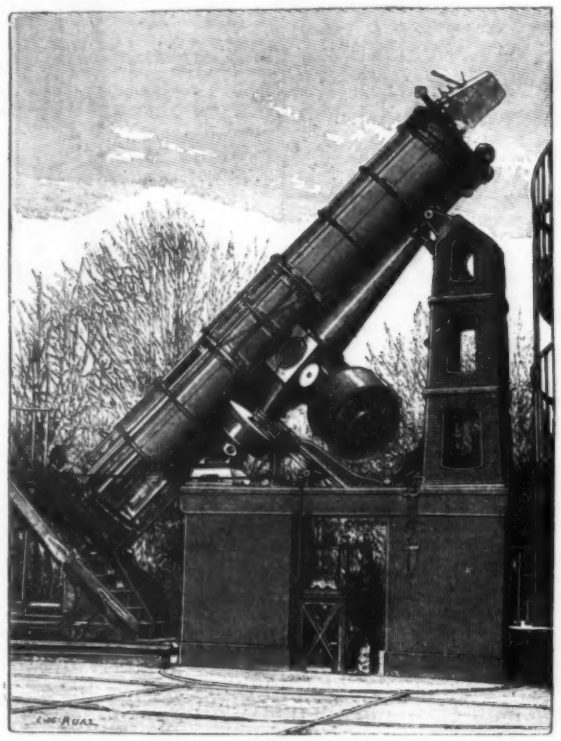


FIG. 1.—THE GREAT TELESCOPE OF THE PARIS OBSERVATORY ARRANGED FOR THE STUDY OF THE VELOCITY OF THE STARS.

the silent solitudes of the heavens, while scientists, those never conquered Titans, add their efforts to scale the sublime summits.

This is but an image, created likewise by the poets, for, riveted to the surface of our modest planet, we scale nothing at all, except in thought—thought served by very imperfect organs. Our eyes are very miserable instruments when it is a question of interrogating the heavens. Upon that host of fixed stars that seem to us invariably inserted like golden nails in the starry vault, they scarcely show us those other stars that are nearer us—the planets which wander through space gravitating around our sun. Primitive and confused ideas of the astral universe which wonderful apparatus, born one after another of the brain of scientists, aid us gradually to clear up, in measure, as more powerful means of investigation extend the limits of the known by unexpected discoveries; so that it is becoming more and more impossible to say where science will halt before an insurmountable barrier.

Thanks to the patient observations that astronomers are accumulating in order that, at the end of remote centuries, other astronomers may examine and compare them, it has been found that all these stars, grouped and forming constellations that are apparently immutable, are not so immovable as they seem to be. By dint of patience, slight displacements have been noted that are appreciable with difficulty to us only because of their extreme remoteness. And, after the dogma of invariability was reached, was it not legitimate to admit that, since all is movement in nature, the celestial bodies, whatsoever they be, do not escape the common rule, but gravitate in space, each upon an orbit proper to it, and all obeying those known laws that govern the celestial mechanics?

Thus all these bodies that fill space form together, despite the enormous distances that separate them, a system of material points that move, and, if all these motions were projected upon any axis whatever, as mathematicians say, we should know in advance that the algebraic sum thereof would be null.

The modesty of us, poor inhabitants of the earth, based however upon the results of observations, forces us to recognize the fact that our sun is not the center around which all these distant stars revolve. It moves in its turn, pulling us along in its train without much effort. Whither is it going? Herschel was the first to fix the direction of the motion, which is carrying it toward a point in the heavens situated in the constellation of Hercules. But it remains to determine with what velocity it is approaching this constellation, and that is not the easiest part of the problem. Although it is relatively easy, in fact, to measure the angular displacements of the stars, which correspond to the component of their velocity in a direction at right angles with the radius that connects them with the earth, ordinary instruments are powerless to determine the component directed according to such radius—the radial velocity.

In order to define the motion completely, it was necessary, however, to measure this radial velocity, and to this effect Mr. Fizeau devised a very ingenious method, which, perfect in theory, has unfortunately for twenty-five years given only uncertain and contradictory results. The merit of having turned it practically to account is due to one of the astronomers of the Paris Observatory, Mr. Henri Deslandres, who has been able to arrange the apparatus so skillfully as to facilitate the operations and give them all the accuracy desirable. The large number of observations that he has already collected will permit him, after they have all been grouped, to evolve from them an absolutely precise idea of the extraordinary velocity with which our solar system is animated. In order to make better understood in what the method that serves as a basis for these operations consists, let us take a comparison in the domain of acoustics, and we know, moreover, the analogy that unites sound and light: are they not both particular modes of the movement of the ether?

If, then, we consider a sonorous source, such source emits vibrations that succeed one another with a greater or less rapidity (whence results the pitch of the sound), while at the same time these vibrations are propagated in a regular series of waves.

Now, let us suppose that the sonorous source displaces itself in approaching the auditor. It is clear that such movement will have the result of reducing the distance that separates the waves in measure with their emission. Consequently, a larger number of vibrations will strike the ear in a given time. The sound that the auditor hears, and that corresponds to this larger number of vibrations, is consequently of greater acuteness than the sound really emitted by the source. The contrary occurs if, instead of approaching, the source becomes more distant.

A passing locomotive on whistling near us offers a characteristic example of this While it is approaching, the sound that reaches us is louder than the real tone of the apparatus at rest. It becomes lower as soon as the locomotive gets beyond us. This is a fact easy to verify.

An analogous phenomenon occurs when it is a question of a luminous source. If it is movable with respect to us, we perceive the vibrations exactly as they are emitted, with their real spacing; but if it approaches or recedes, the vibrations that reach us are greater or fewer in number, so that if we decompose the luminous ray by receiving it in the slit of a spectroscope, the resulting spectrum is displaced, heightened or lowered in tone so to speak, and the rays that characterize such spectrum are transferred toward the violet or the red, according as there is an approach or recession.

Moreover, the amplitude of the displacement of the rays would permit of appreciating the velocity of the source, provided that one had, by a preliminary experiment, fixed the relation of one to another by operating upon the sun, for example, or upon any other star whose radial velocity is well determined.

It will be seen that, although the method is simple in its principle, its application is particularly delicate. In the first place, in order to permit of appreciating the displacement of the rays of the spectrum, it is necessary to juxtapose a spectrum of comparison furnished by a luminous ray emanating from a fixed source, say, for example, an electric spark leaping between two metallic electrodes in a tube filled with hydrogen. This tube should, of course, present the rays that it is desired to observe—those of hydrogen, iron, and calcium especially, which are particularly sharp and fine. The slit of the spectroscope is so arranged that the luminous rays from the star and the source of comparison meet it in placing themselves one above the other, this giving two spectra superposed like the two limbs of a vernier.

Moreover, in order to permit of making the comparison at leisure and of making an accurate measurement of the spacings, photography comes to the aid of the operator, who takes the two spectral images and fixes them upon the sensitized plate.

When, in 1890, Mr. Deslandres organized the series of spectral studies that since then have given so important results, the only instruments disposable at the observatory were the Foucault siderostat and the telescope, 1·2 meters in diameter, the largest instrument of the kind in France.

The siderostat, despite certain advantages, is not powerful enough for studying the light of the stars by the spectroscope, beyond that of those of the first magnitude.

The telescope, on the contrary, on account of the wide surface of its mirror, is well adapted for these researches, which require much light. In return, this mirror is of mediocre quality, from an optical point of view. Its metallic mounting is subject to considerable flexion. Finally, the maneuver of so gigantic an instrument, when it was a question of following a star during long photographic exposures, was so much the more difficult in that the operator was obliged, for the operation, to remain at the upper part of the apparatus, as in all telescopes of the Newton type.

These various inconveniences perhaps sufficiently explain why the great telescope of the Observatory had served but little before it occurred to Mr. Deslandres to apply it to his researches, and had given rise to no work that had been published.

Several happy transformations have remedied some of these defects by permitting, especially, the operator to place himself at the lower part of the instrument to operate it. It was necessary in the first place to arrange upon the telescope a spectroscope of great dispersion and provided with its photographic camera, in such a way that the slit should be situated exactly at the focus of the large mirror, that is to say, at the point where the image of the star forms. To this effect it was necessary to suppress the small mirror, inclined at an angle of 45°, the object of which is to send the image into the ocular where the observer has the eye fixed. This mirror, moreover, has the inconvenience of absorbing a notable portion of the light precisely in its actinic part. Its suppression, therefore, can be only advantageous; but, as it is very necessary to be able to follow the star and to bring it upon the slit of the spectroscope, it has occurred to Mr. Deslandres to substitute a total reflection prism for the small mirror, not upon the line of passage of the useful rays, but upon that of the red ones, which do not serve for photography. These rays are thus led upon the side and may be received in a telescope with a reticule playing the part of the old ocular.

The electric spark that serves as a source of comparison plays between two iron electrodes likewise placed opposite the slit of the spectroscope, all the parts of which are united in a rigid box of steel plate. This box, which is fixed to the upper ring of the telescope, is of no greater thickness than the various parts that form a bridge, as it were, above one of the diameters of the ring in such a way as not to intercept a new portion of the incident light.

This arrangement would not suffice to improve the working conditions of the telescope if another modification, as simple as it is ingenious, did not render it complete and not compel the observer to remain perched at the upper part of the apparatus. The difficulty has been conquered as follows: The slit of the spectroscope is formed in a small plate of polished steel forming a mirror and slightly inclined, so as to send the pencil of rays from the star upon the side toward a 4-inch objective placed in the interior of the tube. The image of the slit and of the stars upon this slit is received by an elbowed ocular placed at the lower part near the large mirror. It is here that is stationed the observer, who, at a distance of twenty-five feet, can direct and keep the star upon the slit by acting at his pleasure upon the rods that control the motions of the telescope and that Mr. Deslandres has properly prolonged. (Figs. 1 and 2.)

Thanks to these arrangements as a whole, it is possible to operate with long photographic exposures, which, prolonged for two hours, permit of obtaining the spectra of stars up to the fourth magnitude. The photographic spectrum has a utilizable length of 4½ inches, and the dispersion is such that, in the blue, a displacement of 0·0008 of an inch corresponds to a velocity of two miles per second, and in the extreme violet, to 1·2 mile. We reproduce in Fig. 3 a copy of a photograph of the spectrum of Capella.

Thus it is that in studying the displacements of the ten distinctest lines of the spectrum of Sirius, it has been found that this star is receding from us with an apparent velocity of + 11·4 miles per second. Now the velocity of the earth in its orbit, projected upon the ray of Sirius, was + 12 miles on the day of observation (March 3, 1891). Therefore, on that day Sirius was approaching the sun with a velocity of — 0·72 mile.

The Observatory of Potsdam has instituted a series of analogous researches, but it is well to remark that the apparatus employed there is much less powerful than the great telescope of Paris, and does not permit of measuring the velocity of more than sixty of the stars of our sky, while, thanks to the wide surface of its mirror, the Paris instrument assures the spectroscopic observation of 250 stars. Those that interest us the most are the stars that surround the constellation of Hercules and the opposite region of the heavens, since they are situated exactly in the path of our sun. They are, fortunately, very numerous and will permit of calculating the velocity of the motion of the solar system in space, which astronomers have not yet succeeded in determining.

Such is, in its entirety, the work undertaken by Mr. Deslandres. It is most novel, and will be, we are sure of it, fecund in important results.

The spectroscopic methods, which constitute an important branch of physical astronomy, are, moreover, susceptible of numerous and important applications that afford a glimpse of a but little explored region of science. In the hands of Mr. Deslandres they have furnished an important contingent to the study of the physical constitution of the sun. It was for the purpose of continuing his learned researches that the astronomer was sent on a mission to the coast of Senegal to observe the total eclipse of the 16th of April.—*La Nature.*

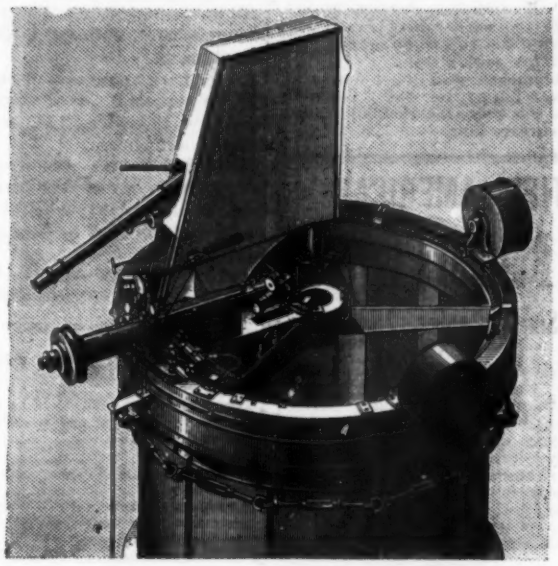


FIG. 2.—NEW ARRANGEMENT OF THE UPPER END OF THE TELESCOPE.

a. Spectroscope. *b.* Microscope for ocular vision. *c.* Electric sources of comparison.

FIG. 3.—SPECTRUM OF CAPELLA COMPARED WITH THE SPECTRA OF IRON, NICKEL, MANGANESE, CALCIUM AND HYDROGEN.

Radial velocity measured eighty-nine miles. (Magnified six times.)

A YOUNG MUSICIAN.

FROM out of the crowd of recitals that is just now overwhelming the London musical world we select for solitary mention that given at Princes' Hall on May 10 by Raoul Koczalski, the Polish wonder child. Recollection of what Josef Hofmann and Otto Hegner were like when they first came out here is sufficiently fresh for exact comparisons to be possible, and the general opinion is that the new prodigy at the age of eight is quite equal, if not in some respects superior, to his above-named predecessors at the age of ten. It follows, therefore, that he is an infinitely greater marvel than either of them. Koczalski's technique seems to be the result of a natural growth rather than an acquired mechanical power, and it stops at nothing that is within the human capacity of his tiny fingers to grasp. He learns and improves without effort, almost without practice, and the sensation of physical fatigue is virtually unknown to him. Apart from this he is a born musician in the sense that he can think, feel and express for himself. These who heard the child play Mozart's D minor Fantasia and Liszt's "Hungarian Rhapsody," No. 13, at his first recital are not likely quickly to forget the experience.—*Illustrated London News.*

KOCZALSKI, THE YOUNG PIANIST.

Eight years of age.

FREDERICK AUGUSTUS GENTH.*

FREDERICK AUGUSTUS GENTH was born May 17, 1820, at Waechersbach, in Hesse-Cassel, where his father occupied the position of "Forstmeister" to Prince Isenburg. He received his early training in the gymnasium at Hanau. His university studies began at Heidelberg. While there, although he exhibited much interest in mineralogical and chemical studies and made frequent botanical and geological excursions, he does not appear to have definitely decided upon his future career. His earliest papers, which he published in 1842, while still a student, in Leonhard-Bronn's *Jahrbuch*, were upon subjects having reference to conchology, geology and mineralogy.

From Heidelberg he proceeded to Giessen, where the fame of that greatest of all teachers of chemistry, Liebig, was attracting students from all parts of the civilized world. There were assembled around this master many men whose names have since become illustrious in chemistry.

When Genth entered the Giessen laboratory, he met among others the two assistants, Fresenius and Will, and as fellow-students with such men as Hofmann, Wurtz, Strecker and Varrentrapp.

The master mind at the head of the laboratory and the scientific atmosphere of the place had doubtless a great influence upon the young student, and gave his studies a definite direction; but it was under the guidance of Fresenius that he began his chemical exercises. In later years Genth was wont to express his indebtedness to this great analyst for having laid the foundation of what was later to become the field of his principal scientific work.

At the same time, however, he continued zealously to cultivate the mineralogical studies, and he seems to have given special attention also to crystallography. . . .

Under Liebig's direction he made and published a chemical investigation of a new resinous body, which was given the name of masopin.

In 1843 he went to complete his university studies with Bunsen at Marburg. This eminent savant also had surrounded himself at this time with a circle of students, many of whom afterward became famous.

* Report of a special committee of the Chemical Section of the Franklin Institute. Read and accepted at the stated meeting held March 31, 1893. Wm. H. Wahl, Harry F. Keller, T. R. Wolf, *committee.*

Among these appear the names of Kolbe, Frankland and Tyndall.

For three years he acted as Bunsen's assistant. His contributions to science during that time were numerous: a few of these related to geology, most of them, however, were on mineral-analytical subjects. The most important of the latter was an investigation of the metallurgical process of the Friedrichshutte near Riechelsdorf.

The results of this well-known research were embodied in the dissertation which, in 1846, he submitted to the Philosophical Faculty of Marburg, which conferred upon him the degree of doctor of philosophy, after he had passed the required examination with high honors. . . .

In the following year, 1848, having meantime married, Genth came to this country. He made his residence in Philadelphia, and the reestablished an analytical laboratory. Most of his time was taken up with commercial work and with the instruction of young men. His leisure he devoted to original research. Thus he was occupied for more than twenty years.

In this time not less than fifty-six contributions from his pen have appeared, with notable regularity, in various scientific journals. His earlier papers appeared in Keller & Tiedemann's *Nordamerikanischer Monatsbericht* and the *Proceedings* of the Academy of Natural Sciences. His later work was published in the *American Journal of Science*, and several important communications appear in the *Journal of the Franklin Institute*.

He held for many years the post of chemist to the State Board of Agriculture of Pennsylvania, being the first to be elected to this office, and practically controlled the fertilizer trade of this State. One of the most important specialists in this branch of manufacture bears testimony that his official work was always regarded as being absolutely reliable. This position he held until the recent establishment of the Agricultural Experiment Station in connection with the State College, to which was transferred the conduct of all researches in the interests of agriculture.

He was also for a number of years mineralogist to the second geological survey of Pennsylvania.

In 1872 he was elected to the chair of chemistry and mineralogy at the University of Pennsylvania. This position he held until 1888, when differences with the administration caused his withdrawal.

He was the recipient of many evidences of appreciation of his scientific work. He was a member of the National Academy, president of the American Chemical Society, and honorary fellow of the American Association for the Advancement of Science. For many years he was an active member of the Academy of Natural Sciences and of the Franklin Institute. He was an honorary member of our section.

Notwithstanding the distractions of commercial work, to which he was compelled to devote much of his time, and, later on, those of a laborious professorship, he was able, thanks to his unflagging scientific enthusiasm and enormous capacity for work, to contribute more than one hundred papers embodying the results of his personal observations and researches during his professional career of about half a century.

In placing an estimate upon the scientific career of the subject of this memoir, it is not too much to say that he was one of the ablest mineralogists, and certainly the foremost mineral analyst, this country has known.

His scientific labors embrace mineralogical, geological and chemical subjects, but valuable as are the results of his chemical researches, his fame will rest chiefly upon the contributions he has made to our knowledge of the minerals of this country. His name appears on almost every page of the records of mineralogy.

His innumerable observations and his careful analyses have helped to throw light upon every class of mineral species. Of the more than one score of well-established species which he added to the list of our minerals, we need only mention a few, such as nickel gymnite (named genthite by Dana), whitneyite, cosalite, coloradoite, psittacinite, aguilarite, calaverite, lansfordite and nesquehonite; but he deserves no less credit for the elimination of doubtful species and the characterization of others that had been imperfectly described.

In connection with his work in this direction, we should not omit to notice the elimination of owenite, harrisite, coracite, cherokine and Endlich's schirmirite, and his characterization of roscolite, hiddenite and herderite. His most important contribution to mineralogy is probably his monograph on *Corundum: Its Alterations and its Associated Minerals*. His ingenious interpretation of the metamorphoses exhibited by this mineral, upon which, as well as his numerous careful analyses, his conclusions as to the character of the alterative operations of nature were based, have now been generally accepted by mineralogists and geologists.

His preliminary report on the mineralogy of Pennsylvania is an invaluable guide to the mineral history of the State, and the same may be said of his report on the minerals of North Carolina.

His contributions to chemistry proper are less numerous, though some are of considerable importance. In this category undoubtedly must be placed his famous discovery of the "ammonia-cobalt bases," the credit of which certainly belongs to him, notwithstanding the almost simultaneous announcement of those compounds by Claudet and Frémy. The joint investigation of these compounds by Gibbs and Genth is a classic research.

His much-quoted paper on "The Metallurgical Process of the Friedrichshutte" is replete with interesting results, notable among which is the discovery of an allotropic form of oxide of nickel contained in the metallic copper. Familiar to all the analytical fraternity is his method of analyzing chrome iron ore and his method of determining copper as oxide.

As a teacher, Genth possessed, in a remarkable degree, the ability to impart knowledge. His method consisted substantially in inducing the student to cultivate the habit of close observation and reasoning, rather than that of committing facts to memory. Many of his students have attained to positions of distinction, and will be able worthily to perpetuate his fame.

The personal character of the man could almost be predicted by those who never enjoyed the privilege of his acquaintance and friendship from the sterling character of his scientific work.

He had in full measure the typical characteristic of the German nature in his love for thoroughness and contempt for superficiality and sham. He was unaffected in manner, and though at times he may have exhibited a certain brusqueness even toward his friends and intimates, this eccentricity served only to attach them more closely to him. To them he was thoroughly devoted, and those who knew him best loved him most. His friendly interest in young men about beginning a scientific career exhibited one of the most charming traits of his nature, and the writers of these inadequate lines, which they affectionately dedicate to his memory, gratefully recall from earlier days the acts of considerate kindness and words of encouragement of the revered master whose life work is done.

His private life was blameless, and in his domestic relations, which were most happy, he was a devoted husband and father. He was twice married, and three sons and five daughters survive him.

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